KOLLMORGEN
Seidel

Digital servo amplifier

SERVOSTAR™ 600

Assembly and Installation Instructions

Edition 08/99

Previous versions :

Edition	Remarks
05/98	First edition
08/98	a few corrections
09/98	various minor corrections, parameter description removed, parameter setting for multi-axis systems and on/off switching behaviour added, Installation/Commissioning divided into two chapters
01/99	614 added, various minor corrections
02/99	Interface relay for digital outputs (pages 26, 43)
06/99	various corrections, cables and connectors removed, choke box added
08/99	24V tolerance, encoder wiring, ventilation

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Safety Instructions

- **Only properly qualified personnel are permitted to perform activities such as transport, installation, commissioning and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, commissioning and operation of the product, and who have the appropriate qualifications for their job. The qualified personnel must know and observe:**

  IEC 364 and CENELEC HD 384 or DIN VDE 0100
  IEC-Report 664 or DIN VDE 0110
  National Accident Prevention Regulations or VBG 4

- **Read this documentation before carrying out installation and commissioning. Incorrect handling of the servo amplifier can lead to personal injury or material damage. It is vital that you keep to the technical data and information on connection requirements (on the nameplate and in the documentation).**

- **The servo amplifiers contain electrostatically sensitive components which may be damaged by incorrect handling. Discharge your body before touching the servo amplifier. Avoid contact with highly insulating materials (artifical fabrics, plastic film etc.). Place the servo amplifier on a conductive surface.**

- **Do not open the units. Keep all covers and switchgear cabinet doors closed during operation. Otherwise there are deadly hazards, with the possibility of severe danger to health or material damage.**

- **During operation, servo amplifiers, according to their degree of enclosure protection, may have uncovered live components. Control and power connections may be live, even if the motor is not rotating.**

- **Servo amplifiers may have hot surfaces during operation. Since the front panel is used for cooling, it can reach temperatures above 80°C.**

- **Never undo the electrical connections to the servo amplifier while it is live. There is a danger of electric arcing with damage to contacts and danger to persons.**

- **Wait at least two minutes after disconnecting the servo amplifier from the mains supply voltage before touching live sections of the equipment (e.g. contacts) or undoing connections. Capacitors can still have dangerous voltages present up to five minutes after switching off the supply voltages. To be sure, measure the voltage in the DC-link circuit and wait until it has fallen below 40V.**

European directives and standards

Servo amplifiers are components which are intended to be incorporated into electrical plants and machines for industrial use.
When the servo amplifiers are built into machines or plants, the intended operation of the amplifier is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Directive on Machines 89/392/EEC and the EC Directive on EMC (89/336/EEC). EN 60204 and EN 292 must also be observed.
In connection with the Low Voltage Directive 73/23/EEC , the harmonized standards of the EN 50178 series are applied to the amplifiers, together with EN 60439-1, EN 60146 and EN 60204.
The manufacturer of the machine or plant is responsible for ensuring that they meet the limits which are required by the EMC regulations. Advice on the correct installation for EMC - such as shielding, grounding, arrangement of filters, treatment of connectors and the laying out of cabling - can be found in this documentation.

CE - conformance

Conformance with the EC Directive on EMC 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of servo amplifiers within the European Community.
The servo amplifiers of the SERVOSTAR™ 600 series have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation. Any divergence from the configuration and installation described in this documentation means that you will be responsible for the performance of new measurements to ensure that the regulatory requirements are met.

UL and cUL- Conformance (listing in 3rd quarter 1999)

UL (cUL)-certified servo amplifiers (Underwriters Laboratories Inc.) fulfil the relevant U.S. and Canadian standard (in this case UL 840 and UL 508C).
This standard describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire, electric shock, or injury to persons, being caused by such equipment. The technical conformance with the U.S. and Canadian standard is determined by an independent UL (cUL) fire inspector through the type testing and regular check-ups.
Apart from the notes on installation and safety in the documentation, the customer does not have to observe any other points in direct connection with the UL (cUL)-certification of the equipment.

UL 508C

UL 508C describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire being caused by such equipment.

UL 840

UL 840 describes the fulfillment by design of air and insulation creepage spacings for electrical equipment and printed circuit boards.

Abbreviations used in this manual

The abbreviations used in this manual are explained in the table below.

Abbrev.	Meaning
AGND	Analog ground
BTB/RTO	Ready to operate
CE	Communité Européenne (EC)
CLK	Clock signal
COM	Serial interface for a PC-AT
DGND	Digital ground
DIN	German Institute for Standards
Disk	Magnetic storage (diskette, hard disk)
EEPROM	Electrically erasable programmable memory
EMV	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic discharge
IEC	International Electrotechnical Commission
IGBT	Insulated Gate Bipolar Transistor
INC	Incremental Interface
ISO	International Standardization Organization
LED	Light-emitting diode
MB	Megabyte
MS-DOS	Operating system for PC-AT
NI	Zero pulse

Abbrev.	Meaning
NSTOP	Limit-switch input for CCW rotation (left)
PC-AT	Personal computer with 80x86 Processor
PELV	Protected low voltage
PGND	Ground for the interface
PSTOP	Limit-switch input for CW rotation (right)
PWM	Pulse-width modulation
RAM	Volatile memory
Rregen	Regen resistor
RBext	External regen resistor
RBint	Internal regen resistor
RES	Resolver
PLC	Programmable logic controller
SRAM	Static RAM
SSI	Synchronous serial interface
SW/SETP.	setpoint
UL	Underwriters Laboratory
V AC	AC voltage
V DC	DC voltage
VDE	Verein deutscher Elektrotechniker
XGND	Ground for the 24V supply

Symbols used in this manual

	danger to personnel from electricity and its effects			general warning general instructions mechanical hazard
⇨ p.	see page (cross-ref.)		●	special emphasis

Keys on the servo amplifier panel :	
▲	**press once** : move up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : move down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**hold right key pressed, and then press left key as well** : to enter number, “Return” function

I General

I.1 About this manual

This manual describes the digital servo amplifiers of the SERVOSTAR™ 600 series (standard version). You can find information about:

● Technical data of the servo amplifier	Chapter I
● Assembly / installation	Chapter II
● Interfaces	Chapter III
● Commissioning the servo amplifier	Chapter IV
● Accessories	Chapter V
● Transport, storage, maintenance, disposal of the servo amp.	Chapter VI

A more detailed description of the expansion cards which are currently available and the digital connection to automation systems can be found on the accompanying CD-ROM in Acrobat-Reader format (system requirements: WINDOWS 95 with Internet browser) in English, German and French versions.
You can print this documentation on any standard printer. A printed copy of the documentation is available from us at extra cost.

This manual makes the following demands on qualified personnel :

Transport :	***only by personnel with knowledge in handling electrostatically sensitive components.***
Installation :	***only by electrically qualified personnel***
Commissioning :	***only by personnel with extensive knowledge of electrical engineering / drive technology***

I.2 Prescribed use (“Use as directed”) of the servo amplifier

The servo amplifiers are components which are built into electrical equipment or machines, and can only be commissioned as integral components of such equipment.

The SERVOSTAR™ 600 family of servo amplifiers is to be used **only** on earthed three-phase industrial mains supply networks (TN-system, TT-system with earthed neutral point).
The servo amplifiers must not be operated on power supply networks without an earth or with an asymmetrical earth.

If the servo amplifiers are used in residential areas, or in business or commercial premises, then additional filter measures must be implemented by the user.

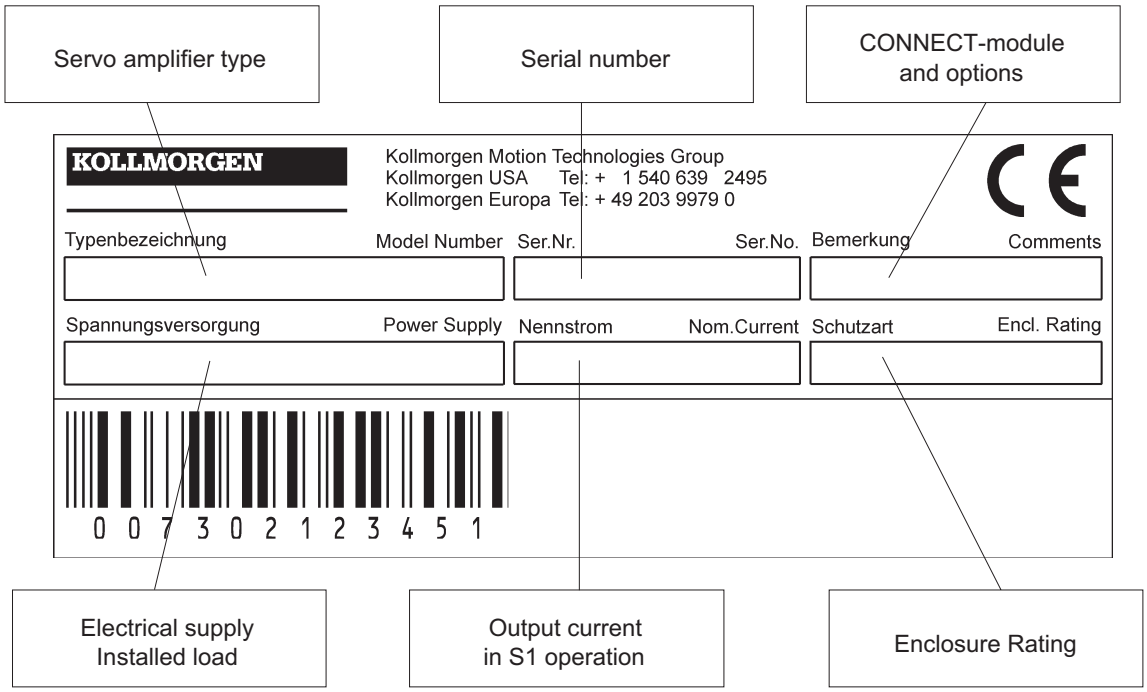
The SERVOSTAR™ 600 family of servo amplifiers is **only** intended to drive specific brushless synchronous servomotors from the 6SM or GOLDLINE™ BH series, with closed-loop control of torque, speed and/or position. The rated voltage of the motors must be at least as high as the DC-link voltage of the servo amplifier.

The servo amplifiers **may only** be operated in a closed switchgear cabinet, taking into account the ambient conditions defined on page 16 .

We only guarantee the conformance of the servo amplifiers with the standards for industrial areas (page 7), if the components (motors, cables, amplifiers etc) are delivered by Seidel.

I.3 Nameplate

The nameplate depicted below is attached to the side of the servo amplifer.
The information described below is printed in the individual fields.



I.4 Instrument description

I.4.1 Package supplied

When you order a SERVOSTAR™ 600 series amplifier from us, you will receive:

— SERVOSTAR™ 6xx
— mating connectors X3, X4, X0A, X0B, X7, X8

The mating SubD connectors and motor connector X9 are not part of the package!

— Assembly, Installation and Commissioning Instructions
— Online documentation on CD-ROM
— Setup software SR600 on 3.5" diskettes

Accessories: (must be ordered separately if required)

— Servomotor 6SM or GOLDLINE™ BH
— motor cable (pre-assembled), or both motor connectors separately, with motor cable as a cut-off length
— feedback cable (pre-assembled, see application note “Cables and connectors”) or both feedback connectors separately, with feedback cable as length
— motor choke 3YL-20 (⇨ p.57), for cable length above 25m
— external regen resistor (⇨ p.56)
— communications cable to the PC(⇨ p.43) or Y-adapter (⇨ p.49) for setting parameters of up to 4 servo amplifiers from one PC
— power cable, control cables, fieldbus cables (as lengths)

I.4.2 The digital servo amplifiers of the SERVOSTAR™ 600 family

Standard version

- 6 current ratings (1.5 A , 3 A , 6 A , 10 A , 14 A, 20 A)
- three instrument widths : 70 mm up to 10A rated current
  100 mm for 14A rated current
  120 mm for 20A rated current
- wide range of rated voltage (3x230V $_{-10\%}$ to 3x480V $^{+10\%}$)
- shield connection directly at the servo amplifier
- two analog setpoint inputs
- integrated CANopen (default 500 kBaud), for integration into CANbus systems and for setting parameters for several amplifiers via the PC-interface of one amplifier
- integrated RS232, electrically isolated
- integrated pulse-direction interface

Options

- -AS- built-in safety relay (personnel-safety starting lock-out), see p. 19 and leaflet “Option -AS-”
- PROFIBUS DP expansion card
- SERCOS expansion card (from 3rd. quarter 1999)
- I/O expansion card

Open architecture

- open hardware and software architecture
- slot for an expansion card
- integrated macro language, including compiler
- prepared for all conceivable customer-specific extensions

I.4.3 Operation directly from supply

Electrical supply

- Directly off grounded 3 phase system, 230V$_{-10\%}$ — 480V$^{+10\%}$, 50 — 60 Hz, TN-system or TT-system with grounded neutral point
- Fusing (e.g. fusible cutout) provided by the user
- single-phase supply (e.g. for commissioning or setting-up) is possible

Auxiliary supply voltage 24V DC

- Electrically isolated, from an external 24V DC psu, e.g. with insulating transformer

Power input filter

- Interference suppression filter for the supply input (to Class A) is integrated
- Interference suppression filter for the 24V aux. supply (to Class A) is integrated

I.4.4 Digital servo amplifier concept

Operation and parameter setting

- With the comfortable Seidel setup software through the serial interface of a PC
- Direct operation by means of two keys on the servo amplifier and a 3-character LED display for status display in case there is no PC available
- Fully programmable via RS232 interface

Power section

- Power supply: B6 rectifier bridge, directly off 3-phase earthed supply system, integral power input filter and inrush circuit
- All shielding connections directly on the amplifier
- Output stage: IGBT- module with isolated current measurement
- Regen circuit: with dynamic distribution of the regen power between several amplifiers on the same DC-link circuit. Internal regen resistor as standard, external regen resistors if required
- DC-link voltage 300 — 900 V DC, can be paralleled

Completely digital control

- Digital current controller (space vector pulse-width modulation, 62.5 µs)
- Freely programmable digital speed controller (250 µs)
- Integral position controller with adaptation possibilities for customer needs (250 µs)
- Pulse direction interface integrated for connection of a servomotor to a stepping- motor control
- Evaluation of the resolver signals or sine-cosine signals of a high-resolution encoder
- Encoder emulation (incremental ROD 426-compatible or SSI)

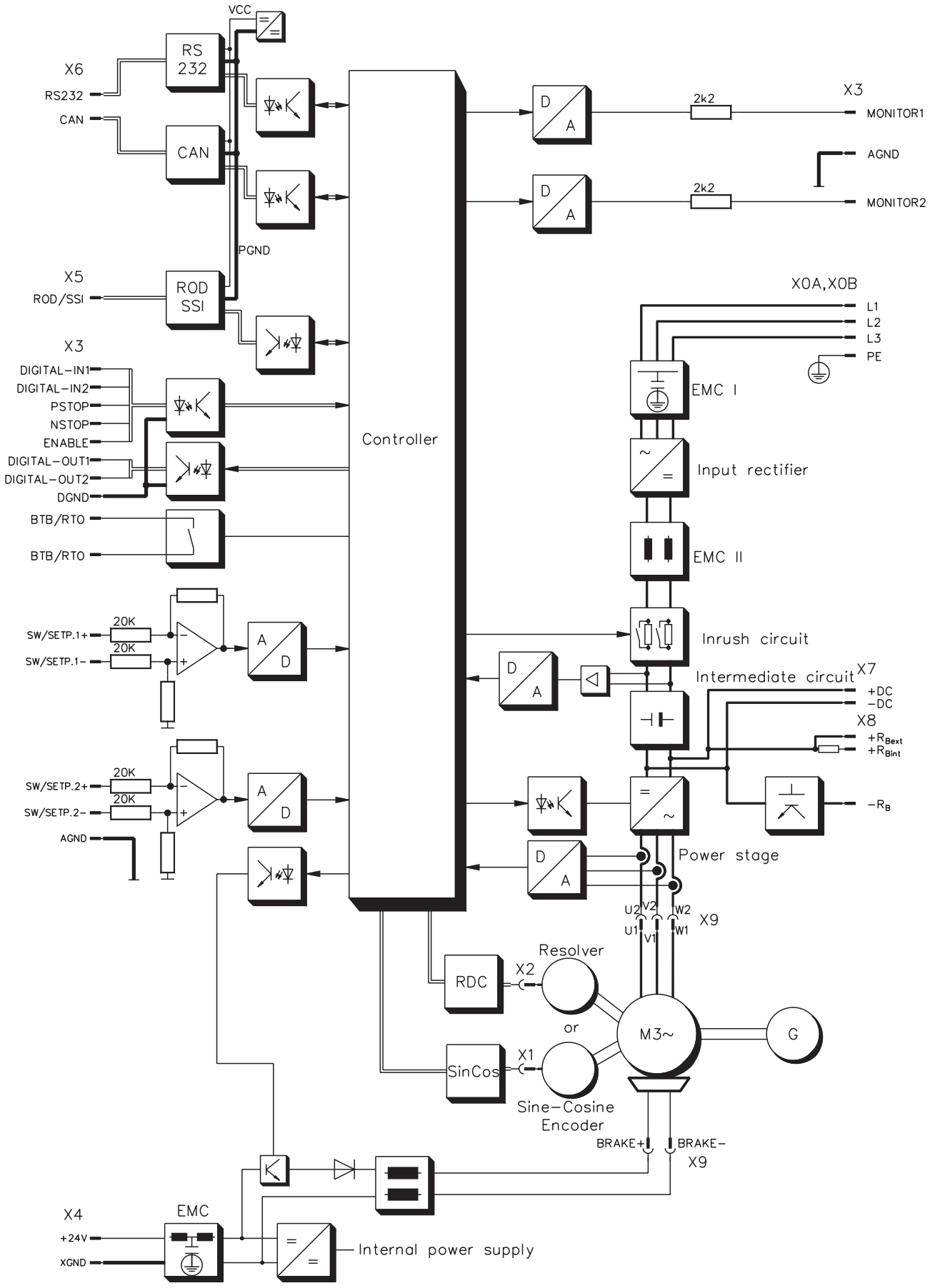
Auxiliary functions

- Adjustable setpoint ramps
- 2 analog monitor outputs
- 4 programmable digital inputs (normally, two are defined as limit-switch inputs)
- 2 programmable digital outputs
- Freely programmable combinations of all digital signals

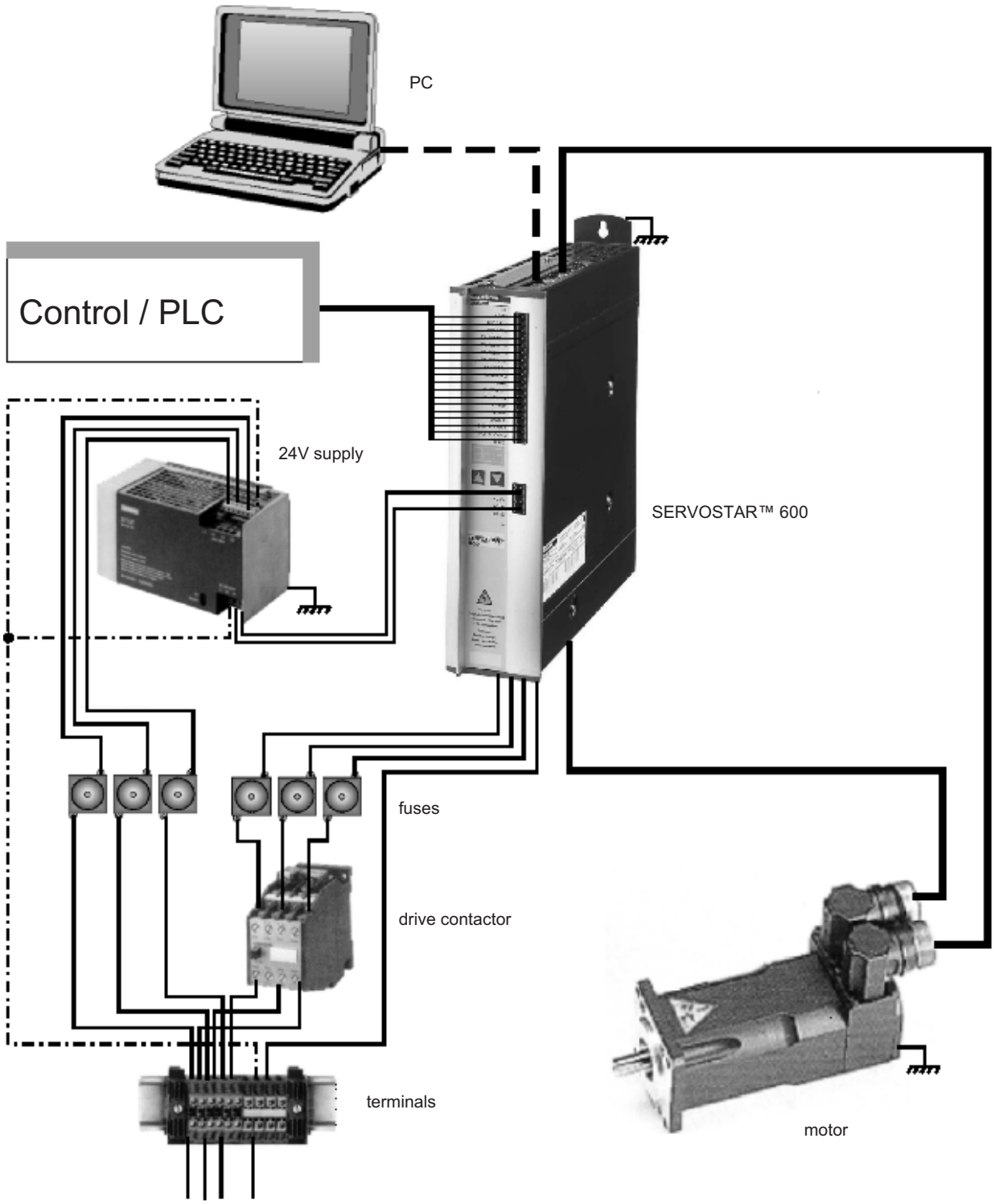
Integrated safety

- Safe electrical separation to EN 50178 between the power input / motor connections and the signal electronics, provided by appropriate insulation/creepage distances and complete electrical isolation
- Soft-start, overvoltage recognition, short-circuit protection, phase-failure monitoring
- Temperature monitoring of servo amplifier and motor
  (when using motors from the 6SM or GOLDLINE™ BH series with our pre-assembled cables)

I.5 Block diagram



I.6 Components of a servo system



I.7 Technical data of the SERVOSTAR™ 600 series

		SERVOSTAR™					
Rated data	**DIM**	**601**	**603**	**606**	**610**	**614**	**620**
Rated supply voltage	V~	3 x 230V$_{-10\%}$ ... 480V$_{+10\%}$, 50 ... 60 Hz					
Rated installed load for S1 operation	kVA	1	2	4	7	10	14
Rated DC-link voltage	V=	310 - 675					
Rated output current (rms value, ± 3%)	A_{rms}	1.5	3	6	10	14	20
Peak output current (max. ca. 5s, ± 3%)	A_{rms}	3	6	12	20	28	40
Clock frequency of the output stage	kHz	8					
Technical data for regen circuit	—	⇨ p.18					
Overvoltage protection threshold	V	450...900					
Form factor of the output current (at rated data and min. load inductance)	—	1.01					
Bandwidth of subordinate current controller	kHz	> 1.2					
Residual voltage drop at rated current	V	5					
Quiescent dissipation, output stage disabled	W	15					
Dissipation at rated current (incl. power supply losses, without regen dissipation)	W	30	40	60	90	160	200
Internal fusing (external fusing ⇨ p.15)							
Auxiliary supply 24V	—	internal 3.15 AT					
Regen resistor	—	internal, electronic					
Inputs							
Setpoint 1/2, resolution 14bit/12bit	V	±10					
Common-mode voltage max.	V	±10					
Input resistance	kΩ	20					
Digital inputs	V	low 0...7 / high 12...36					
	mA	7					
Aux. power supply, electrically isolated	V	24 (-0% +15%)					
without brake	A	1					
Aux. power supply, electrically isolated	V	24 (-0% +15%)					
with brake	A	3					
Max. output current, brake	A	2					
Connections							
Control signals	—	Combicon 5.08 / 18 pole , 2,5mm²					
Power signals	—	Power Combicon 7.62 / 4x4 + 1x6-pole, 4mm²					
Resolver input	—	SubD 9pole (socket)					
Sine-cosine encoder input	—	SubD 15pole (socket)					
PC-interface, CAN	—	SubD 9pole (plug)					
Encoder emulation, ROD/SSI	—	SubD 9pole (plug)					
Mechanical							
Weight	kg	4				5	7.5
Height without connectors	mm	275					
Width	mm	70				100	120
Depth without connectors	mm	265					

I.7.1 External fusing

Fusible cutouts or similar		**SERVOSTAR™ 601 / 603**	**SERVOSTAR™ 606 / 610**	**SERVOSTAR™ 614 / 620**
AC supply	$F_{N1/2/3}$	6 AT	10 AT	20 AT
24V supply	$F_{H1/2}$	max. 16 AF		
Regen resistor	$F_{B1/2}$	4 AF	6 AF	6 AF

I.7.2 Permissible ambient conditions, ventilation, mounting position

Storage temperature/humidity, storage duration	⇨ p.59
Transport temperature / humidity	⇨ p.59
Supply voltage tolerances Input power Aux. power supply	 min 3x230V$_{-10\%}$ AC / max 3x 480V$^{+10\%}$, 50 ... 60 Hz 24 V DC (-0% +15%)
Ambient temperature in operation	0 to +45°C at rated data +45 to +55°C with power derating 2.5% / °C
Humidity in operation	rel. humidity 85%, no condensation
Site altitude	up to 1000m a.m.s.l. without restriction 1000 — 2500m a.m.s.l. with power derating 1.5%/100m
Pollution level	Pollution level 2 to EN60204/EN50178
Enclosure protection	IP 20
Mounting position	generally vertical. ⇨ p.22
Ventilation SERVOSTAR™ 601-620	 built-in fan
Make sure that there is sufficient forced ventilation within the switchgear cabinet.	

I.7.3 Conductor cross-sections

Following EN 60204, we recommend for **single-axis systems**:

AC connection	SERVOSTAR™ 601-610 : 1.5 mm² SERVOSTAR™ 614/620 : 4 mm²	
DC-link	SERVOSTAR™ 601-610 : 1.5 mm² SERVOSTAR™ 614/620 : 4 mm²	Shielded for lengths > 20 cm
Motor cables up to 25 m length	SERVOSTAR™ 601-610 : 1 - 1.5 mm² SERVOSTAR™ 614/620 : 2.5 mm²	Shielded
Motor cables 25 to 100 m length **(consult our applications department)**	SERVOSTAR™ 601-606 : 1 mm² SERVOSTAR™ 610-620 : 2.5 mm²	Shielded, with motor choke 3YL-20
Resolver, thermostat-motor	0.25 mm² twisted pairs, shielded, max.100m	
Setpoints, monitors, AGND	0.25 mm² twisted pairs, shielded	
Control signals, BTB, DGND	0.5 mm²	
Holding brake (motor)	min. 0.75 mm², shielded, check voltage drop	
+24 V / XGND	max. 2.5 mm², check voltage drop	
For multi-axis systems, please note the special operating conditions in your installation		

Technical data for connection cables ⇨p.30 .Observe our application note “Cables and connectors”.

I.7.4 LED display

A 3-character LED display shows the amplifier status after switching on the 24V supply (⇨ p.54). During operation and parameter setting of the amplifier via the keys on the front panel, the parameter and function numbers (⇨ p.51) are displayed, as well as the numbers of any errors which occur (⇨ p.52).

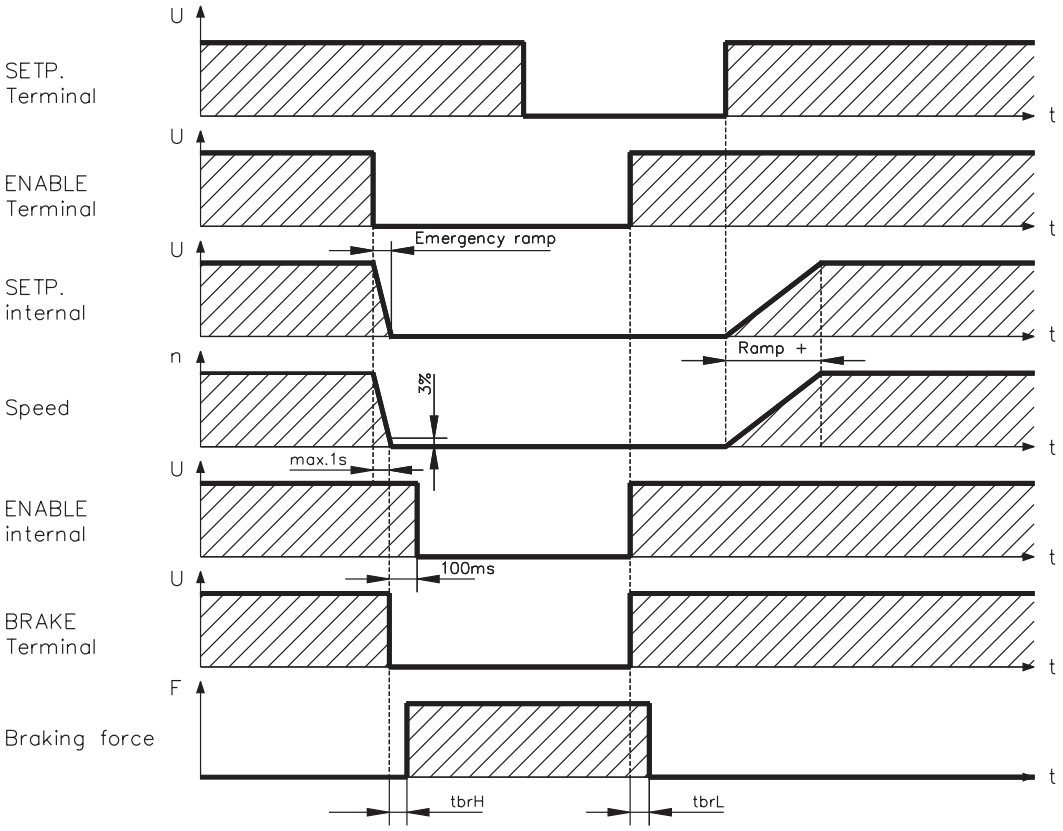
I.8 Grounding system

AGND — ground for analog inputs/outputs, internal analog ground
DGND — ground for digital inputs/outputs, optically isolated
XGND — ground for external 24V aux. voltage, optically and inductively isolated
PGND — ground for encoder emulation, RS232, CAN, optically isolated

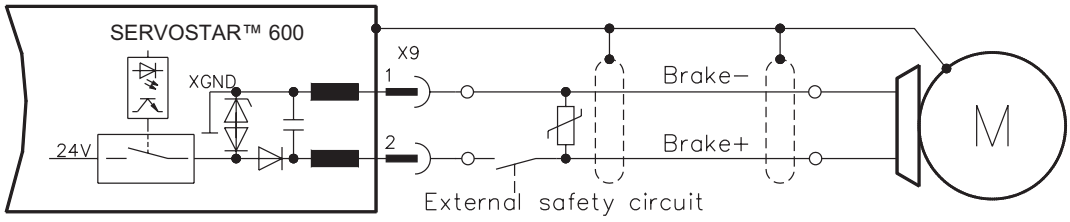
The potential isolation is shown in the block diagram (⇨ p.13).

I.9 Control for motor-holding brake

A 24V / max. 2A holding brake in the motor can be controlled directly by the servo amplifier. **This function does not ensure personnel safety!** The brake function must be enabled through the BRAKE parameter (setting: WITH). In the diagram below you can see the time and functional relationships between the ENABLE signal, speed setpoint, speed and braking force.



During the internal ENABLE delay time of 100ms the speed setpoint of the servo amplifier is internally driven down a 10ms ramp to 0V. The brake output is switched on when 3% of the final speed is reached. The rise (fbrH) and fall (fbrL) times of the holding brake which is built into the motors are different for the various types of motor (see motor manual). A description of the interface can be found on page 34 .
A safe (for personnel) operation of the holding brake requires an additional “make” (n.o.) contact in the brake circuit and a suppressor device (varistor) for the recommended brake circuit diagram :



I.10 Regen circuit

During braking with the aid of the motor, energy is fed back to the servo amplifier. This energy is converted into heat in the regen resistor. The regen circuit (thresholds) are adjusted to the supply voltage with the help of the setup software.
Our applications department can help you with the calculation of the regen power which is required.
A description of the interface can be found on page 34 .

Internal regen resistor	:	SERVOSTAR™ 601/603	66 Ω
		SERVOSTAR™ 606-620	33 Ω
External regen resistor	:	SERVOSTAR™ 601-620	33 Ω

Functional description :

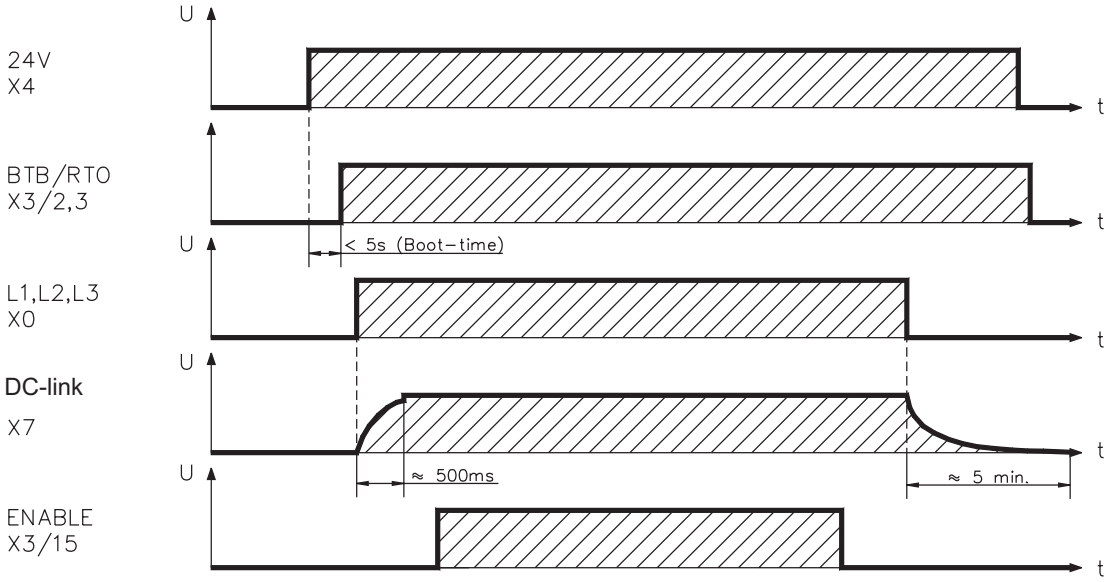
1.- Individual amplifiers, **not coupled** through the DC-link (DC+, DC-)
The circuit starts to respond at a DC-link voltage of 400V, 720V or 840V (depending on the supply voltage). If the energy which is fed back from the motor, as an average over time or as a peak value, is higher than the preset regen power, then the servo amplifier will output the status “regen power exceeded” and the regen circuit will be switched off. At the next internal check of the DC-link voltage (after a few ms) an overvoltage will be detected and the Servo amplifier will be switched off with the error message “Overvoltage” (⇨ p.52). The BTB/RTO contact (terminal X3/2,3) will be opened at the same time (⇨ p.39)

2.- Several servo amplifiers **coupled** through the DC-link circuit (DC+, DC-)
Thanks to the built-in regen circuit with its patented w-characteristic, several amplifiers (even with different current ratings) can be operated off a common DC-link. This is achieved by an automatic adjustment of the regen thresholds (which vary, because of tolerances). The regen energy is distributed equally among all the amplifiers. The **combined power** of all the amplifiers is always available, as continuous or peak power. The switch-off takes place as described under 1. (above) for the servo amplifier with the lowest switch-off threshold (resulting from tolerances). The RTO (BTB) contact of this amplifier (terminals X3/2,3) will be opened at the same time (⇨ p.39).

Regen circuit: technical data			**SERVOSTAR™**	
Supply voltage	**Rated data**	**DIM**	**601 - 603**	**606 - 620**
3 x 230 V	Upper switch-on level of regen circuit	V	400 - 430	
	Switch-off level of regen circuit	V	380 - 410	
	Continuous power of regen circuit (R_{Bint})	W	80	200
	Continuous power of regen circuit (R_{Bext}) max.	kW	0.25	0.75
	Pulse power, internal (R_{Bint} max. 1s)	kW	2.5	5
	Pulse power, external (R_{Bext} max. 1s)	kW	5	
3 x 400 V	Upper switch-on level of regen circuit	V	720 - 750	
	Switch-off level of regen circuit	V	680 - 710	
	Continuous power of regen circuit (R_{Bint})	W	80	200
	Continuous power of regen circuit (R_{Bext}) max.	kW	0.4	1.2
	Pulse power, internal (R_{Bint} max. 1s)	kW	8	16
	Pulse power, external (R_{Bext} max. 1s)	kW	16	
3 x 480 V	Upper switch-on level of regen circuit	V	840 - 870	
	Switch-off level of regen circuit	V	800 - 830	
	Continuous power of regen circuit (R_{Bint})	W	80	200
	Continuous power of regen circuit (R_{Bext}) max.	kW	0.5	1.5
	Pulse power, internal (R_{Bint} max. 1s)	kW	10.5	21
	Pulse power, external (R_{Bext} max. 1s)	kW	21	

I.11 Switch-on and switch-off behaviour

The diagram below illustrates the correct functional sequence for switching the servo amplifier on and off. If you are using the digital output function MAINS-BTB/RTO, you can find a diagram which is valid for this case in the “Setup Software” manual.



I.11.1 Stop function to EN 60204 (VDE 0113)

If a fault occurs (⇨ p.52) the output stage of the servo amplifier is switched off and the BTB/RTO contact is opened. In addition, a global error signal can be given out at one of the digital outputs (terminals X3/16 and X3/17) (see “Setup Software”). These signals can be used by the higher-level control to finish the current PLC cycle or to shut down the drive (with additional brake or similar.).

Instruments which are equipped with a selected “Brake” function use a special sequence for switching off the output stage (⇨ p.17).

The -AS- option can be used to switch off the drive via a positive-action (BG-approved) safety relay, so that personnel safety is ensured at the drive shaft. The -AS- option is described in more detail in a special leaflet. You will find this leaflet on the CD-ROM.

The Stop functions are defined in EN 60204 (VDE 0113), Para. 9.2.2, 9.2.5.3.

There are three categories of Stop functions:

- Category 0: Shut down by immediately switching off the supply of energy to the drive machinery (i.e an uncontrolled shut-down);
- Category 1: A controlled shut-down, during which the supply of energy to the drive machinery is maintained to perform the shut-down, and where the energy supply is only interrupted when the shut-down has been completed;
- Category 2: A controlled shut-down, where the supply of energy to the drive machinery is maintained.

Every machine must be equipped with a Stop function to Category 0. Stop functions to Categories 1 and/or 2 must be provided if the safety or functional requirements of the machine make this necessary.

You can find additional information and implementation examples in our application note “Stop and Emergency Stop functions with SERVOSTAR™ 600”.

I.11.2 Emergency Stop strategies

The Emergency Stop function is defined in EN 60204 (VDE 0113), Para. 9.2.5.4.

Implementation of the Emergency Stop function :

You can find wiring recommendations in our application note
"Stop and Emergency Stop functions with SERVOSTAR™ 600"

Category 0:

The controller is switched to "disable", the electrical supply (400VAC) is disconnected.
The motor leads are disconnected by a changeover switch (contactor, e.g. Siemens 3RT1516-1BB40) and short-circuited by resistors connected in a star configuration.
The drive must be held by an electromagnetic holding device (brake).

Category 1:

If hazardous conditions can result from an emergency stop switch-off with an unbraked run-down, then the drive can be switched off by a controlled shut-down.
Stop Category 1 permits electromotive braking with a switch-off when zero speed has been reached. Safe shut-down can be achieved, when the loss of the mains supply is not rated as a fault and the control takes over the disabling of the servoamplifier.
In the normal situation, only the supply power is switched off in a safe manner.
The 24V auxiliary supply remains switched on.

II Installation

II.1 Important instructions

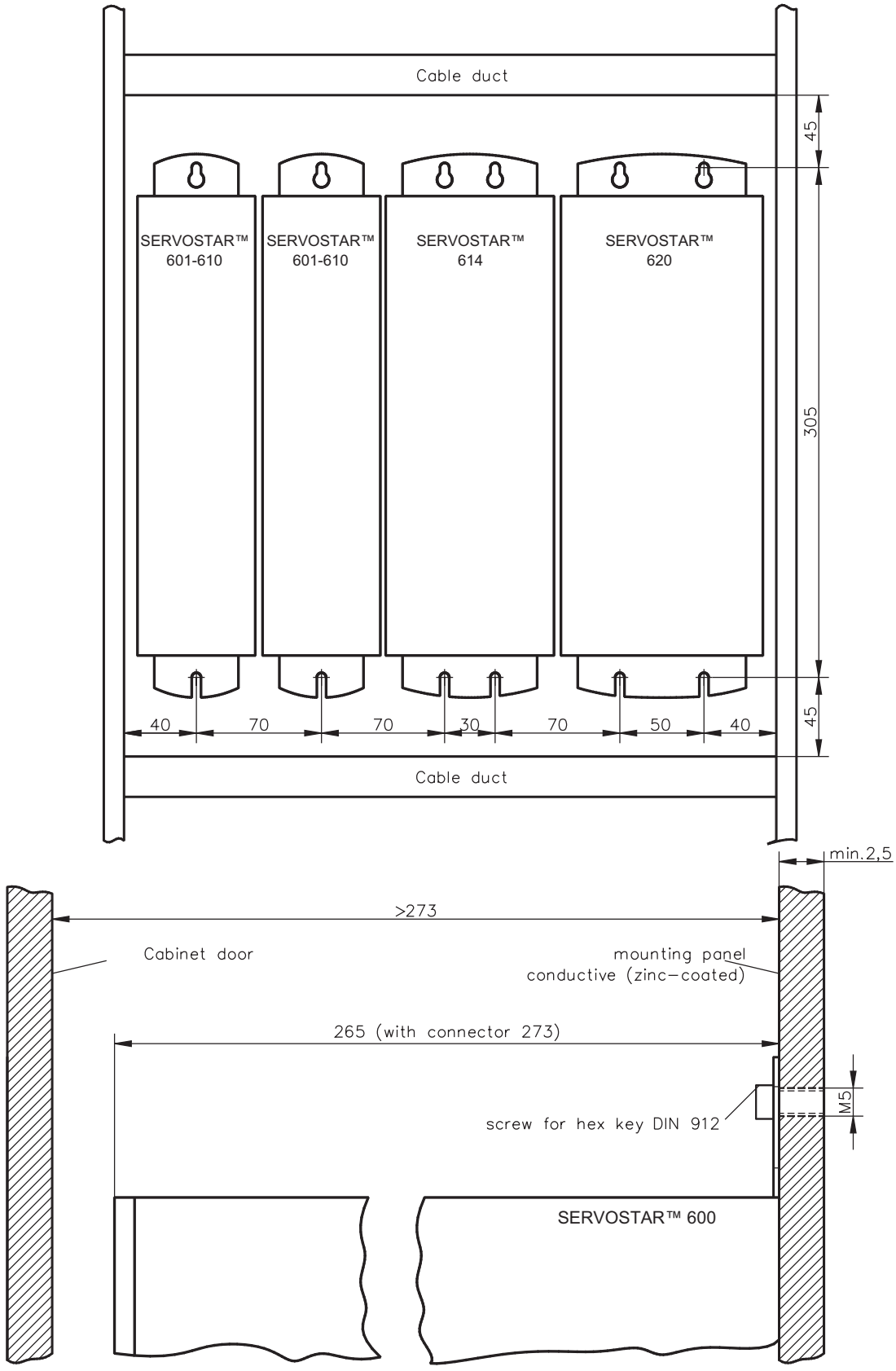
- Protect the servo amplifier from impermissible stresses. In particular, do not let any components become bent or any insulation distances altered during transport and handling. Avoid contact with electronic components and contacts.
- Check the combination of servo amplifier and motor. Compare the rated voltage and current of the units. Carry out the wiring according to the connection diagram on page 24
- Make sure that the maximum permissible rated voltage at the terminals L1, L2, L3 or +DC, –DC is not exceeded by more than 10% even in the most unfavourable case (see EN 60204-1 Section 4.3.1). An excessive voltage on these terminals can lead to destruction of the regen circuit and the servo amplifier. Use the SERVOSTAR™ 600 servo amplifiers only on an earthed 3-phased supply system, to drive a synchronous servomotor of the 6SM or GOLDLINE™ BH series.
- The fusing of the AC supply input and the 24V supply is installed by the user (⇨ p.15).
- Take care that the servo amplifier and motor are earthed properly. Do **not** use painted (non-conductive) mounting plates.
- Route power and control cables separately. We recommend a separation of at least 20 cm. This improves the interference immunity required by EMC regulations. If a motor power cable is used which includes cores for brake control, **the brake control cores must be separately shielded**. Earth the shielding at both ends (⇨ p.26).
- Install all heavy-current cables with an adequate cross-section, as per EN 60204. (⇨ p.16).
- Wire the BTB/RTO contact in series into the safety circuit of the installation. Only in this way is the monitoring of the servo amplifier assured.
- Install all shielding with large areas (low impedance), with metallised connector housings or shield connection clamps where possible. Notes on connection techniques can be found on page 29 and in the application note “Cables and connectors”.
- Ensure that there is an adequate flow of cool, filtered air into the bottom of the switchgear cabinet. Observe page 16 .
- It is permissible to alter the servo amplifier settings by using the setup software. **Any other alterations will invalidate the warranty.**

Caution
Never disconnect the electrical connections to the servoamplifier while it is live. In unfavourable circumstances this could result in destruction of the electronics.
Residual charges in the capacitors can have dangerous levels up to 300 seconds after switching off the mains supply voltage. Measure the bus voltage at the DC-link pins (+DC/-DC), and wait until the voltage has fallen below 40V.
Control and power connections can still be live, even when the motor is not rotating.

II.2 Assembly

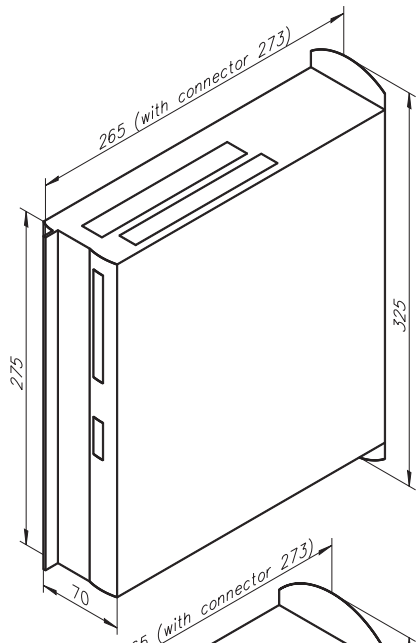
Material : 2 or 4 hexagon socket screws to DIN 912, M5

Tool required : 4 mm Allen key

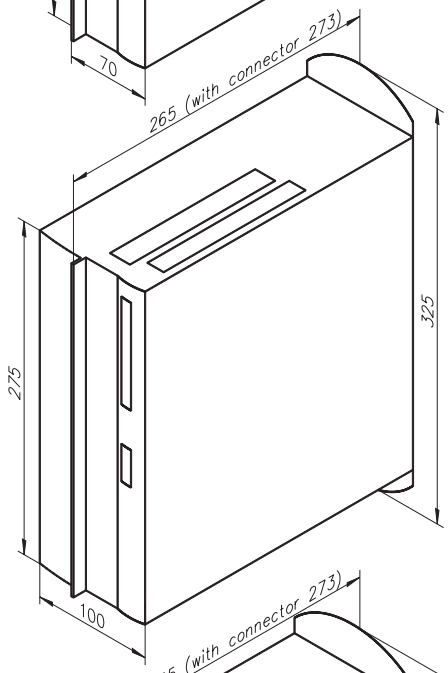


II.2.1 Dimensions of SERVOSTAR™ 600

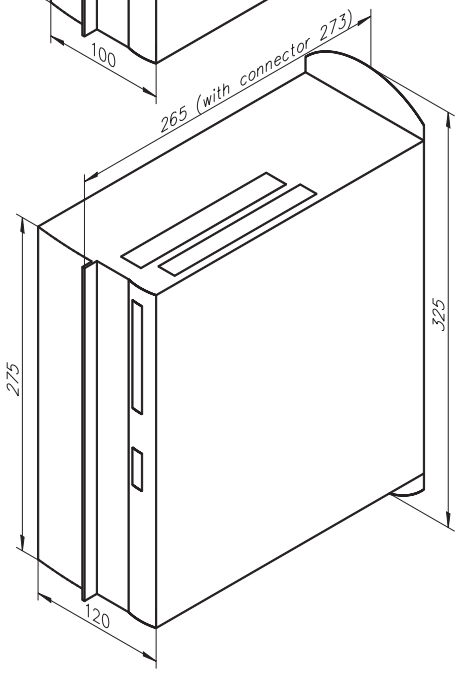
SERVOSTAR™ 601/603/606/610



SERVOSTAR™ 614



SERVOSTAR™ 620



II.3 Wiring

Only professional staff who are qualified in electrical engineering are allowed to install the servo amplifier.

The installation procedure is described as an example. A different procedure may be sensible or necessary, depending on the application of the equipment.

We provide further know-how through **training courses** (on request).

Caution !
Only install and wire up the equipment when it is not live, i.e. when neither the mains power supply nor the 24 V auxiliary voltage nor the operating voltages of any other connected equipment is switched on.
Take care that the cabinet is safely disconnected (with a lock-out, warning signs etc.).
The individual voltages will be switched on for the first time during commissioning.

Note !

The ground symbol ⏚, which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest possible area between the unit indicated and the mounting plate in the switchgear cabinet.
This connection is for the effective grounding of HF interference, and must not be confused with the PE- symbol ⏚ (a protective measure to EN 60204).

Use the following connection diagrams:

- ***Power and control connections : Page 26***
- ***Resolver : Page 35***
- ***High-resolution encoder : Page 36***
- ***Encoder emulation ROD : Page 41***
- ***Encoder emulation SSI : Page 42***
- ***RS232 / PC : Page 43***
- ***CAN-interface : Page 44***
- ***Pulse direction interface : Page 45***
- ***Master-slave interface : Page 46***
- ***Multi-axis systems, example : Page 27***
- ***Expansion card : Connection diagram in the corresponding manual on the CD-ROM***

The following notes should assist you to carry out the installation in a sensible sequence, without overlooking anything important.

Site

In a closed switchgear cabinet. Observe page 16 .
The site must be free from conductive or corrosive materials.
For the mounting position in the cabinet ⇨ p.22

Ventilation

Check that the ventilation of the servo amplifier is unimpeded and keep within the permitted ambient temperature ⇨ p.16 .
Keep the required space clear above and below the servo amplifier ⇨ p.22.

Assembly

Assemble the servo amplifier and power supply close together on the conductive, **earthed** mounting plate in the cabinet.

Cable selection

Select cables according to EN 60204 ⇨ p.16

Grounding Shielding

EMC-compliant shielding and grounding (⇨ p.26)
Earth the mounting plate, motor housing and CNC-GND of the controls.
Notes on connection techniques are on page 29

Wiring

— **Route power leads and control cables separately**

— **Wire the BTB/RTO contact in series into the safety loop of the installation**

— Connect the digital control inputs to the servo amplifier

— Connect up AGND

— Connect the analog setpoint, if required

— Connect up the feedback unit (resolver or encoder)

— Connect the encoder emulation, if required

— Connect the expansion card (see corresponding manual on the CD-ROM)

— Connect the motor leads
Connect shielding to EMC connectors at both ends
Use motor chokes (3YL20) for lead lengths >25m

— Connect motor-holding brake, connect shielding to EMC connectors at both ends

— If required, connect the external regen resistor (with fusing)

— Connect aux. supply
(for max. permissible voltage values ⇨ p.16)

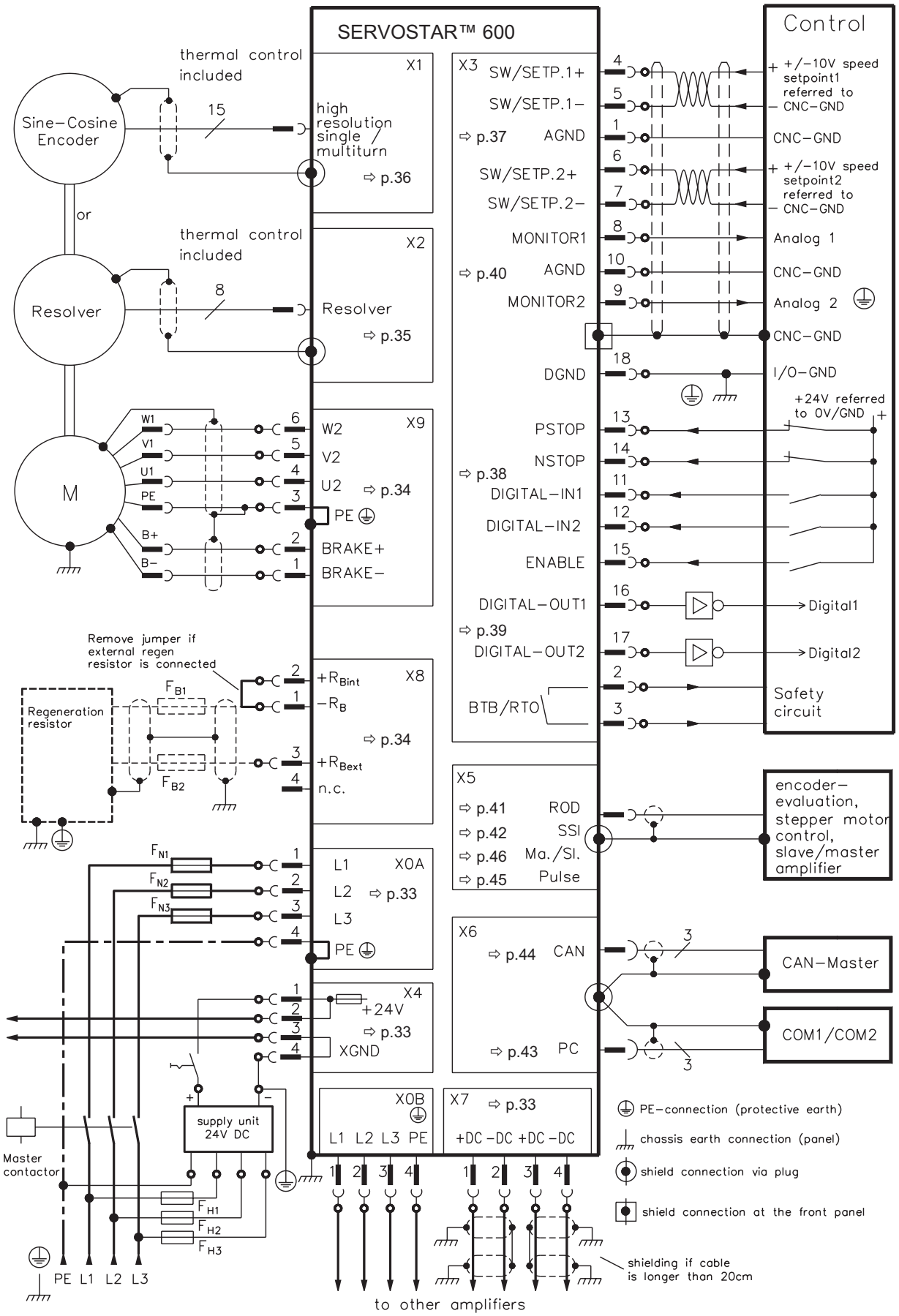
— Connect main power supply
(for max. permissible voltage values ⇨ p.16)

— Connect PC (⇨ p.43).

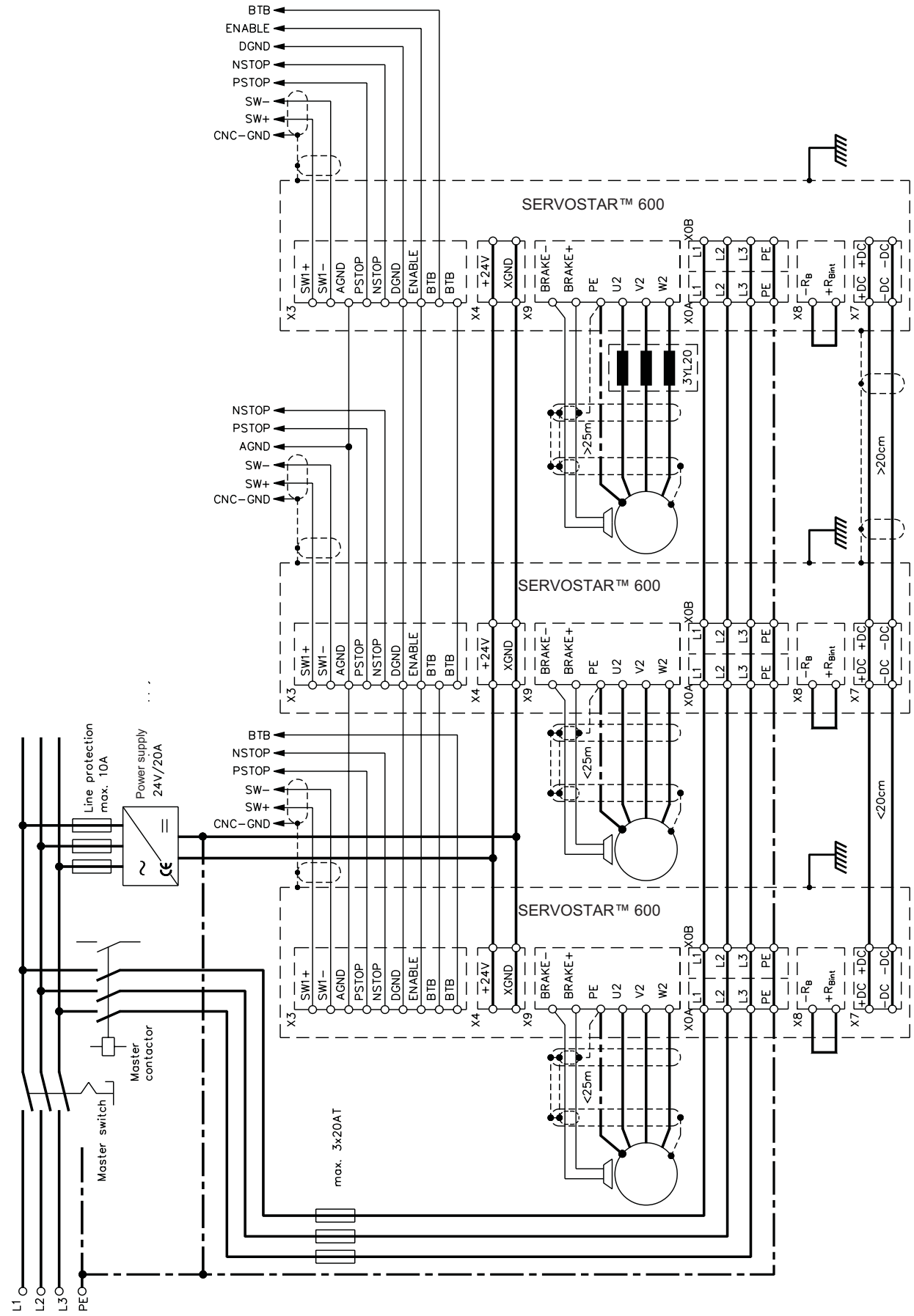
Final check

— Final check of the implementation of the wiring, according to the wiring diagams which have been used.

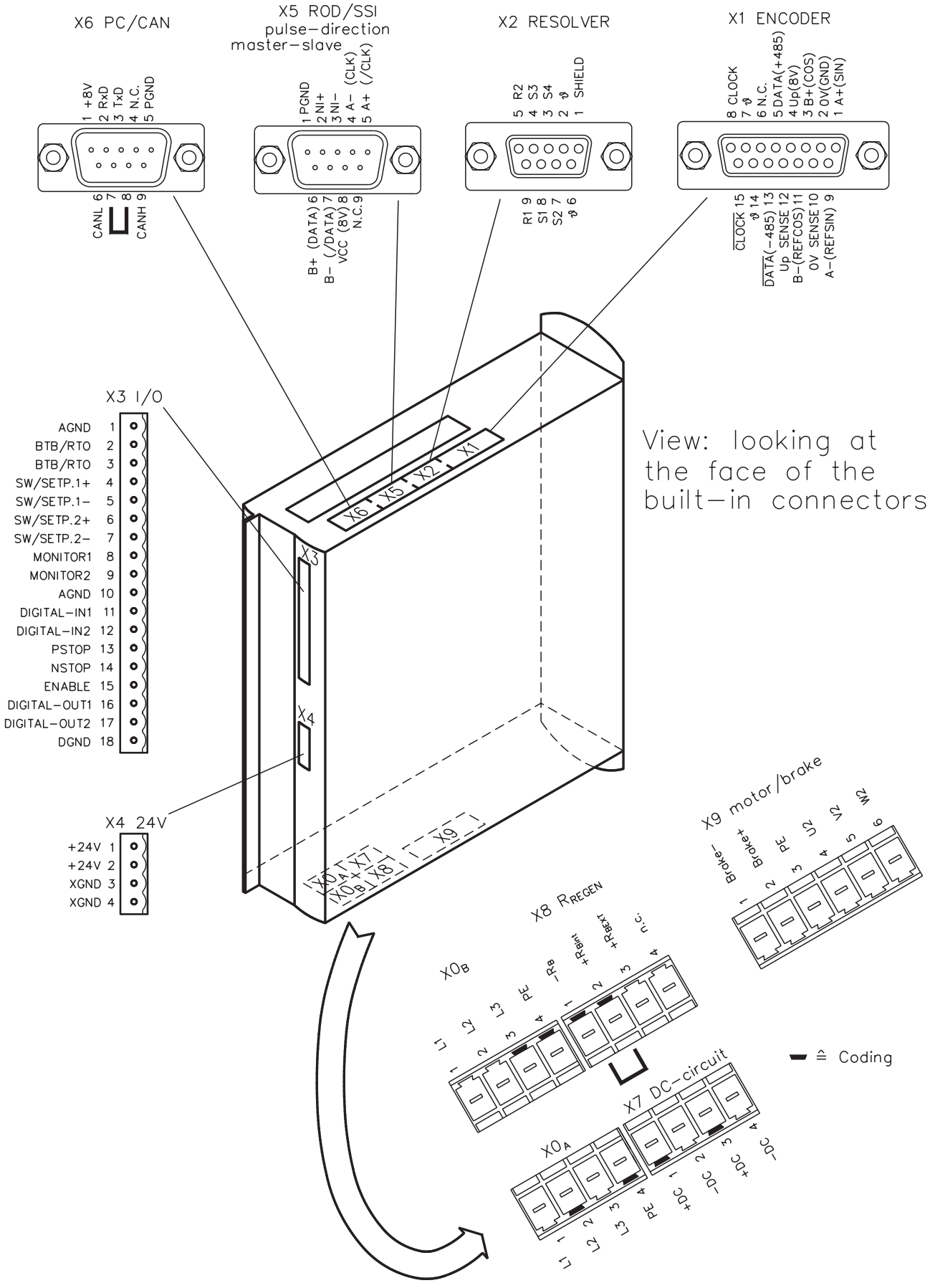
II.3.1 Connection diagram for SERVOSTAR™ 600



II.3.2 Example of connections for multi-axis system



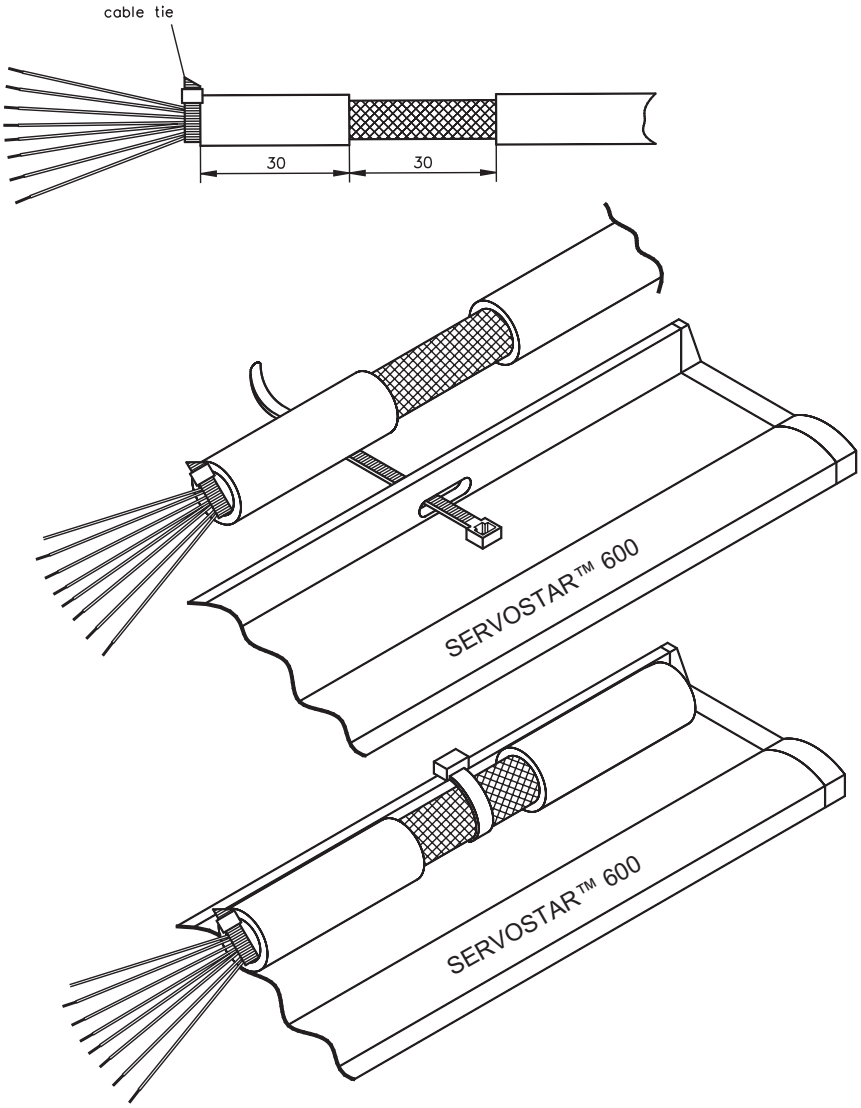
II.3.3 Pin assignments for SERVOSTAR™ 600



II.3.4 Notes on connection techniques

Please consider our application note “Cables and connectors”

II.3.4.1 Shielding connection to the front panel



Remove the outer covering of the cable and the shielding braid from the cores for the required length. Secure the cores with a cable tie.

Remove the outer covering of the cable over a length of about 30mm, without damaging the shielding braid.

Pull a cable tie through the slot in the shielding rail (front panel) of the servo amplifier.

Use the cable tie to clamp the shielding braid of the cable firmly to the shielding rail.

II.3.4.2 Technical data for connecting cables

Further information on the chemical, mechanical and electrical characteristics of the cables can be obtained from our applications department.

Insulation material

Sheathing - PUR (polyurethane, code 11Y)
Core insulation - PETP (polyesteraphtalate, code 12Y)

Capacitance

Motor cable - less than 150 pF/m
RES-cable - less than 120 pF/m

Technical data

— The brackets in the cable designation indicate the shielding.
— All cables are suitable for use as trailing cables.
— The technical data refer to the use as moveable cables.
Operating life : 1 million bending cycles

Cores [mm²]	Coretype	Operation-Temperature range [°C]	Outside diameter [mm]	Bending radius [mm]	Remarks
(4x1.0)	colour	-30 / +80	10	100	
(4x1.5)	letter	-30 / +80	10,5	105	
(4x2.5)	number	-5 / +70	12,6	125	
(4x4)	number	-5 / +70	12,8	130	
(4x1.0+(2x0.75))	colour	-30 / +80	10,5	100	
(4x1.5+(2x0.75))	letter	-10 / +80	11,5	120	
(4x2.5+(2x1))	letter	-30 / +80	12,5	125	
(4x2x0,25)	colour	-30 / +80	6,9	60	twisted pairs
(10x2x0.14)	colour	-30 / +80	8,8	80	

II.3.4.3 Assignment of motors

The following table describes the assignment of the servo amplifiers with the most common synchronous-servomotors from our program. You will find further motors in the motor manuals.

Amplifier	Motor	Motor No.	Connection method	Motor cable
SERVOSTAR™ 601	6SM27M-4000	1	Connector	4 x 1 up to 4 x 1.5mm²
	6SM37S-6000	3		
	6SM37M-6000	5		
	GOLDLINE BH-122-A	521		
	GOLDLINE BH-222-B	527		
SERVOSTAR™ 603	6SM37L-4000	7	Connector	4 x 1 up to 4 x 1,5mm²
	6SM47L-4000	9		
	6SM57S-3000	11		
	GOLDLINE BH-126-B	512		
	GOLDLINE BH-226-E	523		
SERVOSTAR™ 606	6SM57M-3000	13	Connector	4 x 1 up to 4 x 1.5mm²
	6SM77K-3000	15		
	6SM37VL-6000	23		
	GOLDLINE BH-226-C	513		
	GOLDLINE BH-424-D	524		
SERVOSTAR™ 610	6SM77S-3000	17	Connector	4 x 1.5mm²
	GOLDLINE BH-426-B	514	Connector	4 x 1 up to 4 x 1.5mm²
	GOLDLINE BH-622-B	525	Terminal box	4 x 2.5mm²
SERVOSTAR™ 614	6SM107K-3000	19	Connector	4 x 2.5mm²
	GOLDLINE BH-624-D	504	Terminal box	4 x 2.5mm²
	GOLDLINE BH-426-D	529	Connector	4 x 1.5mm²
SERVOSTAR™ 620	6SM107S-3000	21	Connector	4 x 2.5mm²
	GOLDLINE BH-626-E	531	Terminal box	4 x 2.5 up to 4 x 4mm²
	GOLDLINE BH-822-D	532	Terminal box	4 x 2.5 up to 4 x 4mm²

II.4 Setup software

II.4.1 General

This chapter describes the installation of the setup software for the SERVOSTAR™ 600 digital servo amplifiers.

We offer training and familiarisation courses on request.

II.4.1.1 Use as directed

The setup software is intended to be used for setting up and storing the operating parameters for the SERVOSTAR™ 600 series of servo amplifiers. The attached servo amplifier is commissioned with the assistance of the software - during this process the drive can be controlled directly by the service functions.

Only professional personnel who have the relevant expertise described on page 9 are permitted to carry out online parameter setting for a drive which is running.
Sets of data which are stored on data media are not safe against unintended alteration by other persons. After loading a set of data you must therefore check all parameters thoroughly before enabling the servo amplifier.

II.4.1.2 Software description

The servo amplifiers must be adapted to the requirements of your installation. Usually you will not have to carry out this parameter setting yourself on the amplifier, but on a PC, with the assistance of the setup software. The PC is connected to the servo amplifier by a null-modem cable. The setup software provides the communication between SERVOSTAR™ 600 and the PC.

You will find the setup software on the accompanying diskette and the CD-ROM.

With very little effort you can alter parameters and instantly observe the effect on the drive, since there is a continuous (online) connection to the amplifier.
Simultaneously, important actual values are read out from the amplifier and displayed on the PC monitor (oscilloscope function).

Any interface modules (expansion cards) which may be built into the amplifier are automatically recognized, and the additional parameters which are required for position control or motion-block definition are made available.

Sets of data can be stored on data media (archived) and loaded again. Sets of data which are stored on data media can be printed.

We supply you with motor-specific default sets of data for all the reasonable combinations of servo amplifier and motor. In most applications you will be able to use these default values to get your drive running without any problems.

II.4.1.3 Hardware requirements

The PC interface (X6, RS232) of the servo amplifier is connected to the serial interface of the PC by a null-modem cable (**not a null-modem link cable !**) (⇨ p.43).

Connect / disconnect the interface cable only when the supply is switched off for both the PC and the servo amplifier.

The interface in the servo amplifier is electrically isolated by an optocoupler, and is at the same potential as the CANopen interface.

Minimum requirements for the PC:

Processor	:	80486 or higher
Operating system	:	WINDOWS 95/98, WINDOWS NT
Graphics adapter	:	Windows compatible, colour
Drives	:	3.5" diskette drive hard disk with at least 5 MB free space CD-ROM drive for online documentation
Main memory	:	at least 8MB
Interface	:	one free serial interface (COM1: or COM2:)

II.4.1.4 Operating systems

WINDOWS 95 / WINDOWS 98 / WINDOWS NT

SR600.EXE is executable under WINDOWS 95 / 98 and WINDOWS NT 4.0.

WINDOWS FOR WORKGROUPS 3.xx

SR600.EXE is not executable under WINDOWS 3.xx

DOS, OS2

The WINDOWS setup software does not run under DOS or OS2. Emergency operation is possible with an ASCII terminal-emulation (without user interface).
Interface setting : 9600 kBaud, no parity, no handshake

II.4.2 Installation under WINDOWS 95 /98 / NT

An installation program called **SETUP.EXE** can be found on the diskette (or on the CD-ROM) which makes it easy to install the setup software on your PC.

Connection to the serial interface of the PC:
Connect the interface cable to a serial interface on your PC and the PC interface (X6) of the SERVOSTAR™ 600 (⇨ p.43).

Switch-on:
Switch on your PC-AT and the monitor.
After the start phase (boot-up) is finished, the Windows user-interface appears on the screen.

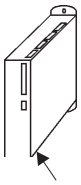
Installation:
Click on **START** (Taskbar), then on **Run**. Enter the program call in the entry window:
a:\setup.exe (with the correct drive letter for a:).
Click on **OK** and follow the instructions.

III Interfaces

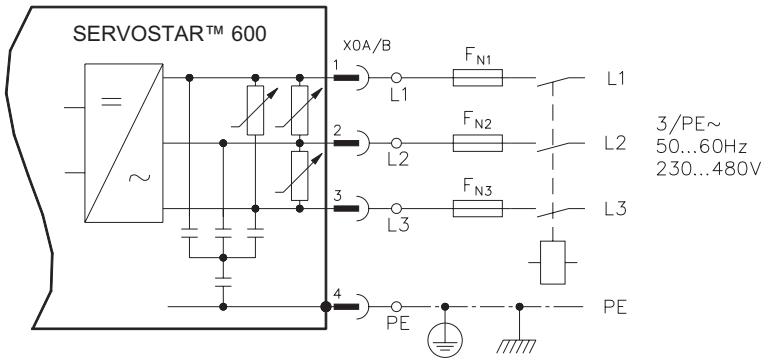
All important interfaces are shown in this Chapter. The precise location of the connectors and terminals can be seen on page 28.

III.1 Power supply

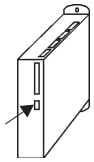
III.1.1 Mains supply connection (X0)



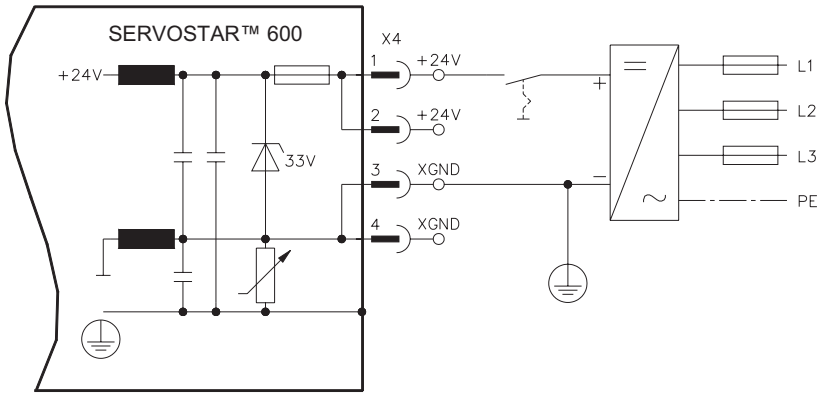
— Directly to earthed 3~ supply, $230V_{-10\%}$ — $480V^{+10\%}$, 50 — 60 Hz, integrated filter
— Fusing (e.g. fusible cut-outs) provided by the user ⇨ p.15



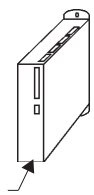
III.1.2 24V auxiliary supply (X4)



— Electrically isolated, external 24V DC supply, e.g. with insulating transformer
— Required current rating ⇨ p.15
— Integrated EMC filter for the 24V auxiliary supply

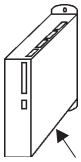


III.1.3 DC-link (X7)

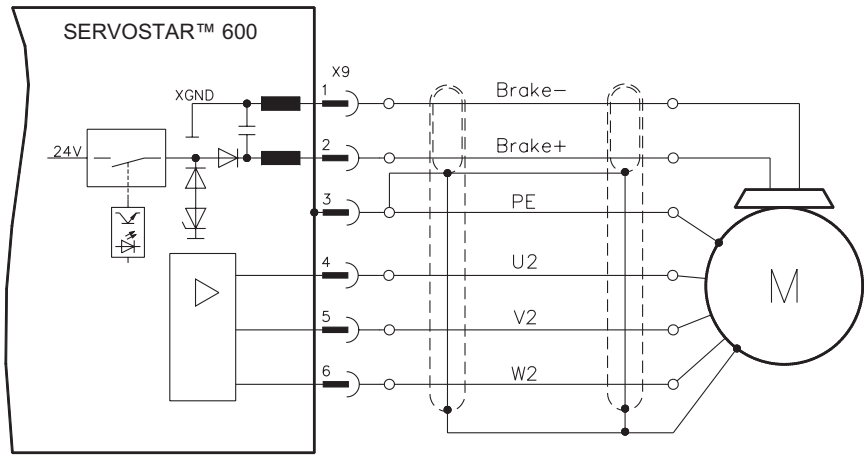


Can be connected in parallel. A patented circuit distributes the regen power among all the amplifiers connected to the same DC-link circuit. (Connection example ⇨ p.27).

III.2 Motor connection with brake (X9)

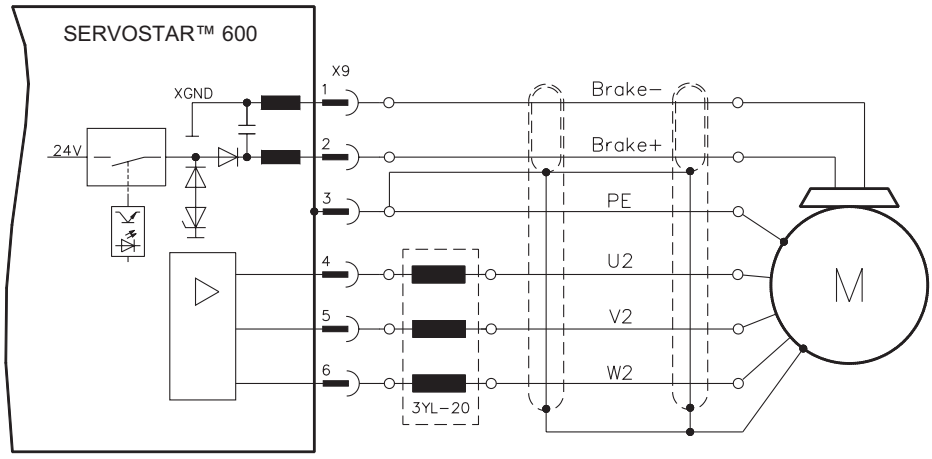


Lead length ≤ 25m

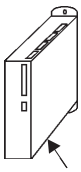


Lead length >25m

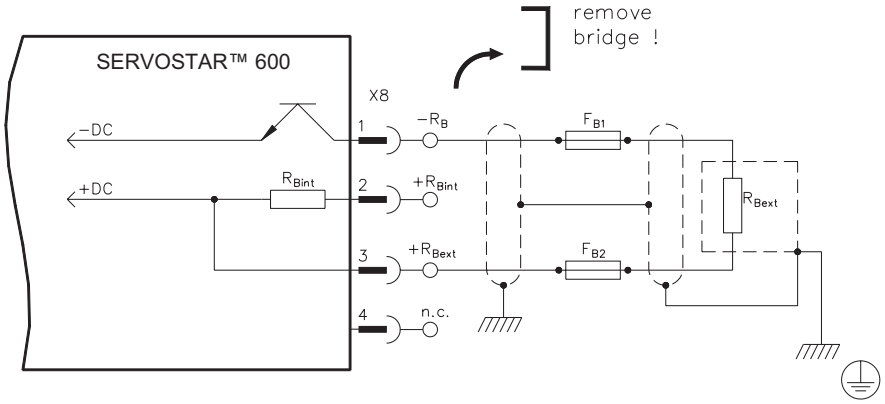
For lead lengths above 25m the choke box 3YL-20 must be wired into the motor lead, close to the amplifier.



III.3 External regen resistor (X8)

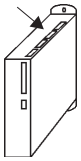


Remove the plug-in link between the terminals X8/1 (-R_B) and X8/2 (+R_{bint}).

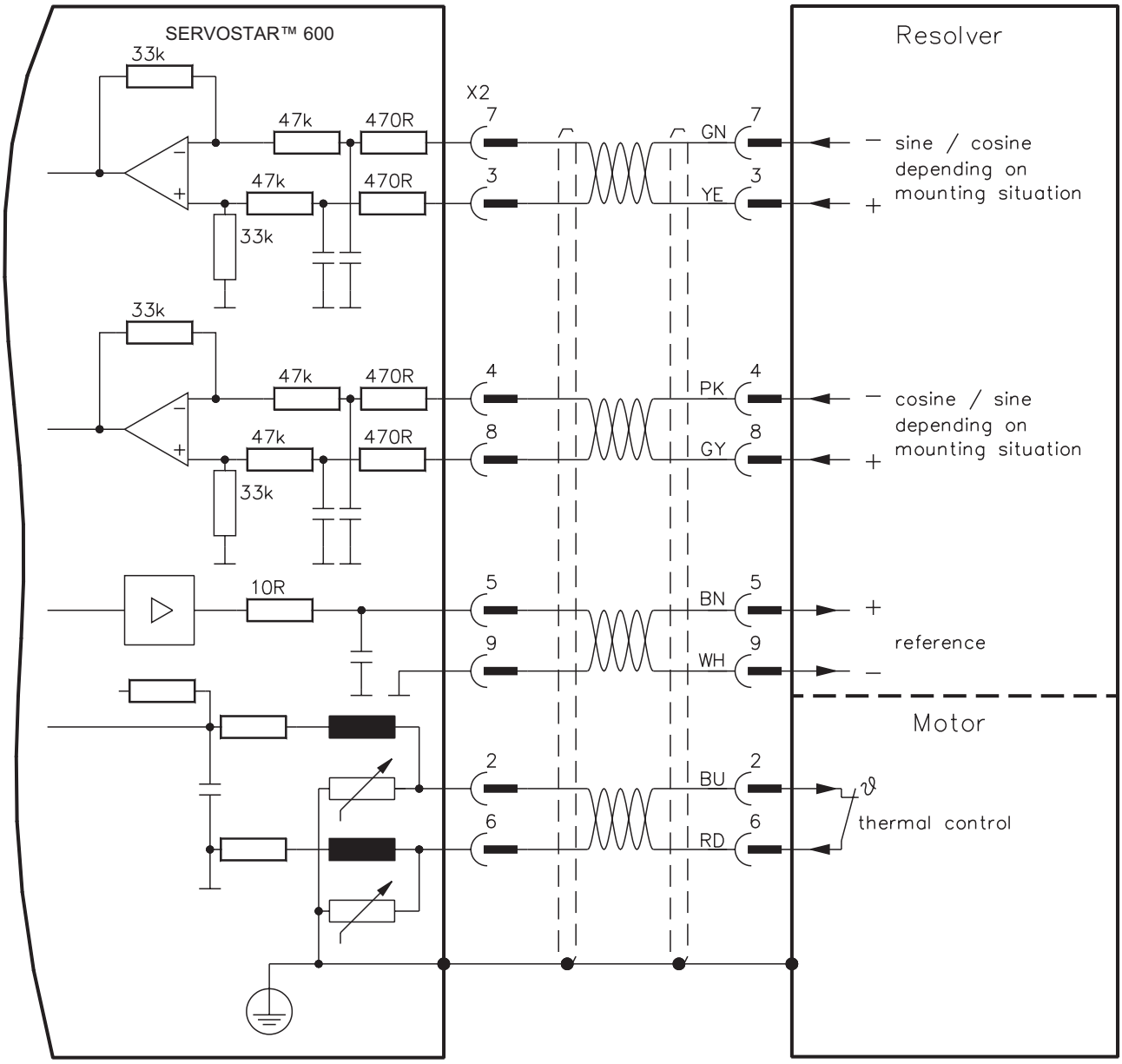


III.4 Feedback

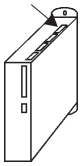
III.4.1 Resolver connection (X2)



The motors of the 6SM or GOLDLINE™ BH series have 2-pole hollow-shaft resolvers built in as a standard. It is possible to connect 2, 4 or 6-pole resolvers to the SERVOSTAR™ 600.
If lead lengths of more than 100m are planned, please contact our application department.
The thermostat contact in the motor is connected via the resolver cable to the SERVOSTAR™ 600 and evaluated there.



III.4.2 Encoder (X1)

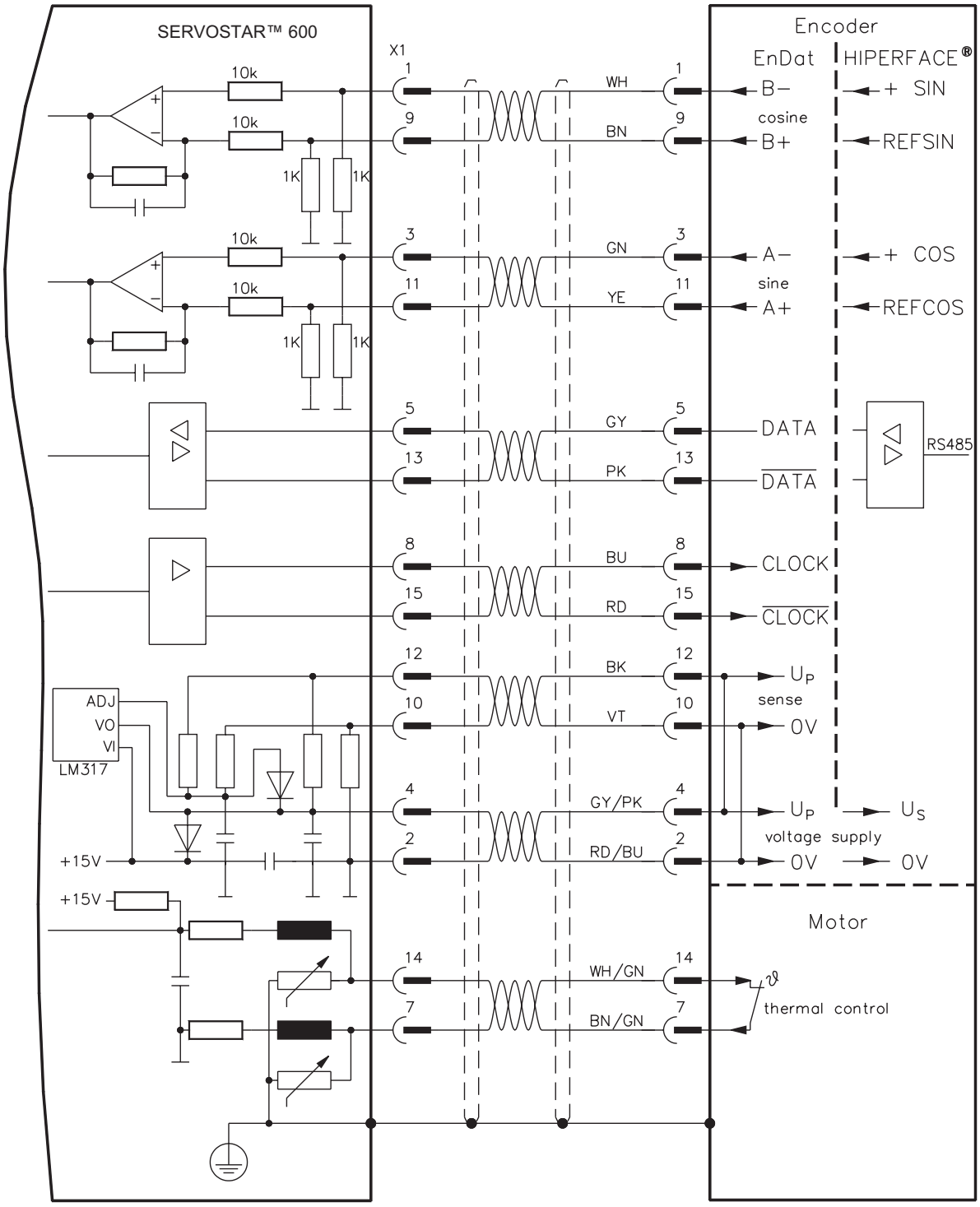


As an option, the 6SM series of motors can be fitted with a single-turn or multiturn sine-cosine encoder.

This encoder is used by the SERVOSTAR™ 600 as a feedback device for drive tasks which require highly precise positioning or extremely smooth running.

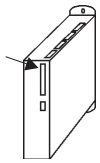
If lead lengths of more than 100m are planned, please consult our applications department.

The thermostat contact in the motor is connected via the resolver cable to the SERVOSTAR™ 600 and evaluated there.



III.5 Control signals, monitor signals

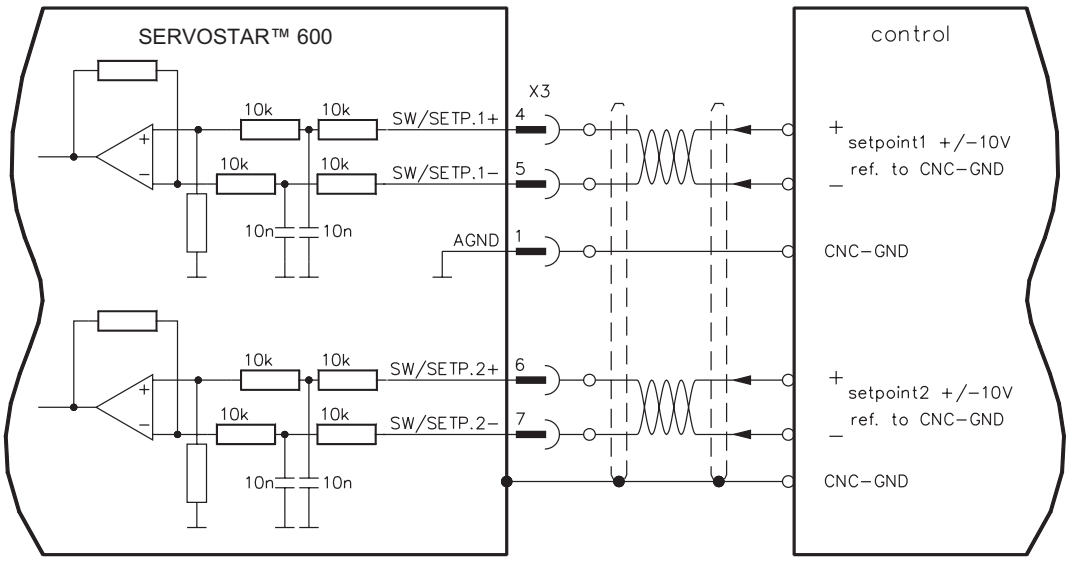
III.5.1 Analog setpoint inputs (X3)



The servo amplifier is equipped with two differential inputs for analog setpoints which are **freely programmable** (with the aid of the macro-language, consult our applications department). AGND (X3/1) must always be joined to the CNC-GND of the controls as a ground reference.

Technical characteristics

— Differential-input voltage max. ± 10 V
— Resolution 1.25 mV
— Ground reference : AGND, terminal X3/1
— Input resistance 20 kΩ
— Common-mode voltage range for both inputs ± 10 V



Input SW/SETP.1 (terminals X3/4-5)
Differential input voltage max. ± 10 V, resolution 14-bit, scalable
Standard setting : speed setpoint

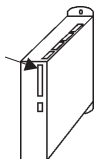
Input SW/SETP.2 (terminals X3/6-7)
Differential input voltage max. ± 10 V, resolution 12-bit, scalable
Standard setting : torque setpoint

Application examples for setpoint input SW/SETP.2:
— adjustable external current limit
— reduced-sensitivity input for setting-up/jog operation
— pre-control / override

Fixing the direction of rotation
Standard setting : clockwise rotation of the motor shaft (looking at the shaft end)
— Positive voltage between terminal X3/4 (+) and terminal X3/5 (-) or
— Positive voltage between terminal X3/6 (+) and terminal X3/7 (-)

To reverse the direction of rotation, swap the connections to terminals X3/4-5 and. X3/6-7 or change the ROT. DIRECTION parameter in the “Speed controller” screen.

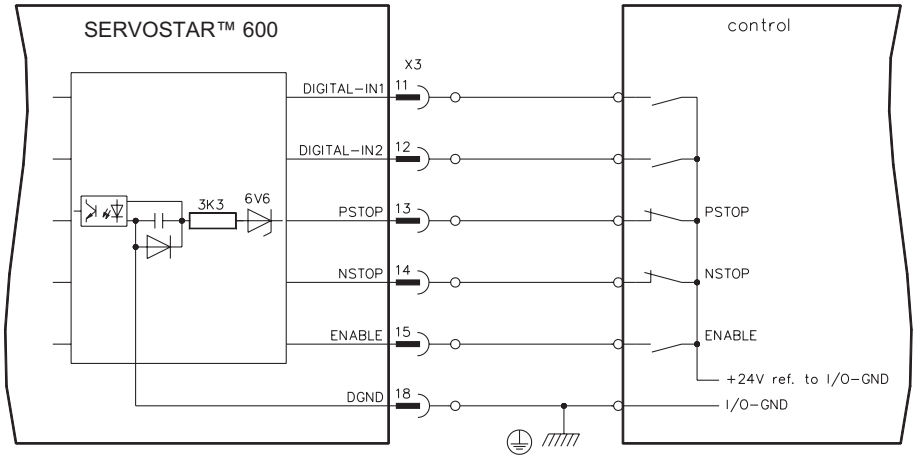
III.5.2 Digital setpoint inputs (X3)



All digital inputs are **electrically isolated** through optocouplers.

Technical characteristics

— Reference ground is **digital**-GND (DGND, terminal X3/18)
— The logic is dimensioned for +24V / 7mA (**PLC-compatible**)
— H-level of +12 — 30V / 7mA, L-level of 0 — 7V / 0 mA



ENABLE input

The output stage of the servo amplifier is activated by the enable signal (terminal X3/15, input 24V, **active-high**).
In the inhibited state (low signal) the motor which is attached does not have any torque.

Freely programmable digital inputs :

You can use the digital inputs PSTOP / NSTOP / DIGITAL-IN1 and DIGITAL-IN2 to initiate pre-programmed functions that are stored in the servo amplifier.
You will find a list of the pre-programmed functions in the SETUP SOFTWARE manual.
Additional special functions can be freshly defined with the aid of the macro language (consult our applications department).
If an input is freshly assigned to a pre-programmed function, then the data set must be stored in the EEPROM of the servo amplifier, and the 24V auxiliary supply of the servo amplifier must be switched off and on again (to reset the amplifier software).

Limit-switches PSTOP / NSTOP

Terminals X3/13 and X3/14 are normally programmed for the connection of limit switches. If these inputs are not needed for the connection of limit switches, then they are freely programmable for other input functions.

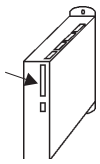
Limit-switch positive/negative (**PSTOP / NSTOP**, terminals X3/13 and X3/14), high level in normal operation (fail-safe for a cable break).

A low signal (open) inhibits the corresponding direction of rotation, **the ramp function remains effective**.

DIGITAL-IN 1 / DIGITAL-IN 2

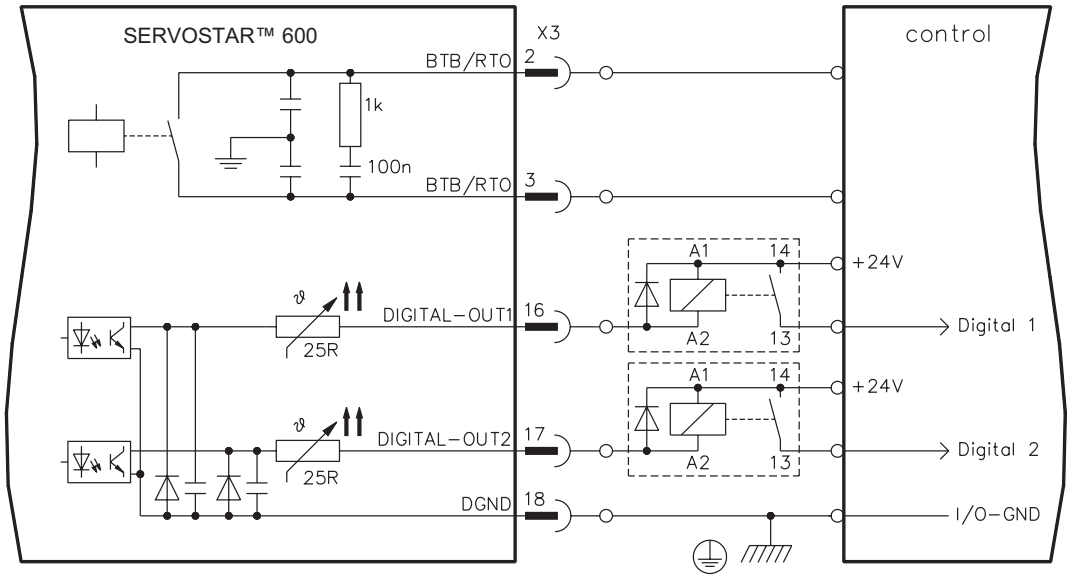
The digital inputs on terminal X3/11 (DIGITAL-IN 1) or terminal X3/12 (DIGITAL-IN 2) can be logically combined in a freely programmable function.

III.5.3 Digital control outputs (X3)



Technical characteristics

— Reference ground is digital-GND (DGND, terminal X3/18)
— All digital outputs are floating
— DIGITAL-OUT1 and 2 : Open-collector, max. 30V DC, 10 mA
BTB/RTO : Relay output, max. 30V DC or 42V AC, 0.5A



Ready-to-operate contact BTB/RTO

Operational readiness (terminals X3/2 and X3/3) is signalled by a **floating** relay contact.
The contact is **closed** when the servo amplifier is ready for operation, the signal is **not** influenced by the enable signal, the I²t- limit, or the regen threshold.

All faults cause the BTB/RTO contact to open and the switch-off of the output stage.
A list of the error messages can be found on page 52.

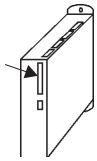
Freely programmable digital outputs DIGITAL-OUT 1 / 2:

You can use the digital outputs DIGITAL-OUT1 (terminal X3/16) and DIGITAL-OUT2 (terminal X3/17) to output messages from pre-programmed functions that are stored in the servo amplifier. You will find a list of the pre-programmed functions in the SETUP SOFTWARE manual.
Additional special functions can be defined with the aid of the macro language (consult our applications department).
If an input is freshly assigned to a pre-programmed function, then the data set must be stored in the EEPROM of the servo amplifier, and the 24V auxiliary supply of the servo amplifier must be switched off and on again (to reset the amplifier software).

Evaluate the outputs via inverting interface relays (see connection diagram), for example Phönix DEK-REL-24/I/1 (turn-on delay 6 ms, turn-off delay 16ms).

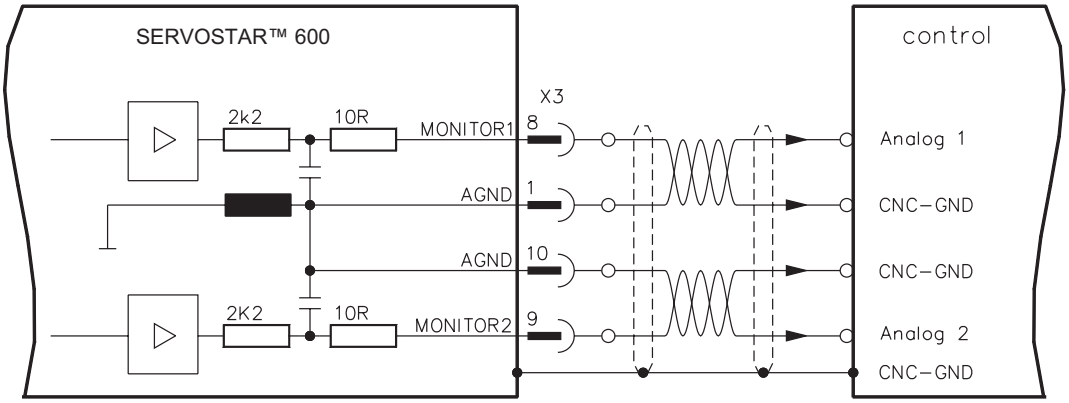
The described logic in the SETUP SOFTWARE manual refers to the output of the inverting interface relays. Consider the delay of the applied relay !

III.5.4 Monitor outputs (X3)



Technical characteristics

— Reference ground is analog-GND (AGND, terminal X3/1 and X3/10)
— Output resistance : 2.2kΩ
— Output voltage ±10V
— Resolution : 10 bit.



Programmable analog outputs MONITOR 1 / MONITOR 2

The terminals X3/8 (MONITOR 1) or X3/9 (MONITOR 2) can have the following analog signals assigned to them:

You can use the terminals X3/8 (MONITOR 1) or X3/9 (MONITOR 2) to output converted analog values for digital measurements which are contained in the servo amplifier.
You will find a list of pre-programmed measurements in the SETUP SOFTWARE manual.
Additional special functions can be defined with the aid of the macro language (consult our applications department).

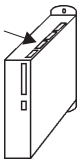
Standard setting :

Monitor 1 : Tachometer voltage **VTA** (speed)
The output delivers ±10V at the preset limit speed.

Monitor 2 : Current setpoint **IDC** (torque)
The IDC-monitor delivers ± 10V at the preset peak current (effective r.m.s. value).

III.6 Encoder emulations

III.6.1 Incremental-encoder interface (X5)



The incremental-encoder interface is part of the package supplied.
Select the encoder function ROD (screen page “Encoder”).

In the servo amplifier, the position of the motor shaft is calculated from the cyclic-absolute signals of the resolver or encoder.

Incremental-encoder compatible pulses are generated from this information.

Pulses are output on the SubD-connector X5 as two signals, A and B, with 90° phase difference and a zero pulse.

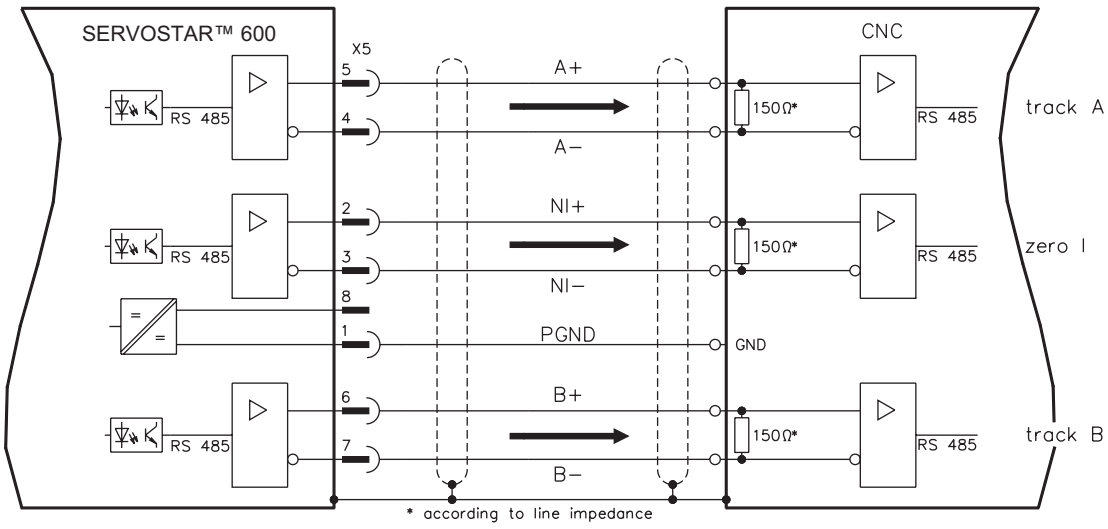
The resolution can be changed with the RESOLUTION parameter:

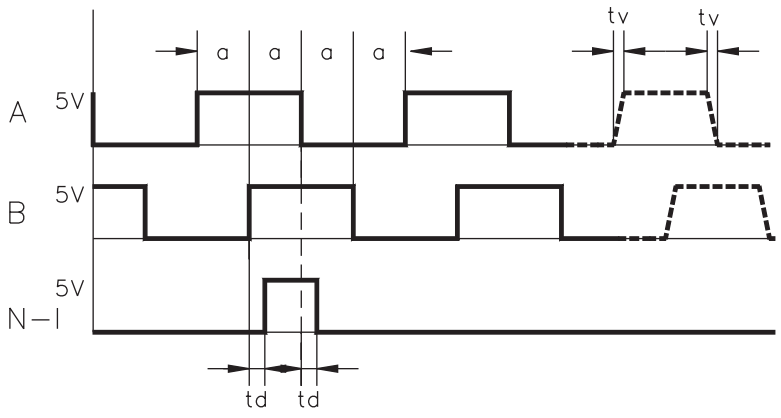
256/512/1024	pulses per turn for Feedback=Resolver
2048/4096	pulses per turn for Feedback=EnDat or HIPERFACE
8192	pulses per turn for Feedback=EnDat or HIPERFACE up to 3000 rpm
16384	pulses per turn for Feedback=EnDat or HIPERFACE up to 1500 rpm

You can also adjust and store the position of the zero pulse within one mechanical turn (parameter NI-OFFSET). Because of the compatibility with normal commercial pulse encoders, you can only set the zero pulse when A=B=1.

The drivers are supplied from an internal supply voltage.
PGND must always be connected to the controls.

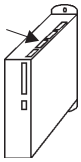
Connections and signal description for incremental-encoder interface :





Edge spacing a ≥ 8 µs
U_H ≥ 2,0V/–20mA
U_L ≤ 0,5V/+20mA
Edge steepness tv ≤ 0.1 µs
Delay N–I–td ≤ 0.1 µs
Scanning frequency > 160kHz
Limit speed 6000 rpm

III.6.2 SSI-Interface (X5)



The SSI interface (synchronous serial absolute-encoder emulation) is part of the delivered package. Select the encoder function SSI (screeen page “Encoder”).

In the servo amplifier, the position of the motor shaft is calculated from the cyclic-absolute signals of the resolver or encoder. A position output is generated from this information, compatible with the data format of normal commercial SSI absolute encoders. This synchronous, serial, cyclic-absolute 12-bit information is output on the SubD-Connector X5.

24 bits are transmitted. The upper 12 bits are fixed at zero, the lower 12 bits contain the position information. Exception : If a SinCoder (Stegmann) is used as a feedback device, then the upper 12 bits are held at 1 (invalid data !) until a reference traverse has been carried out, and then they will be set to ZERO (valid data !).

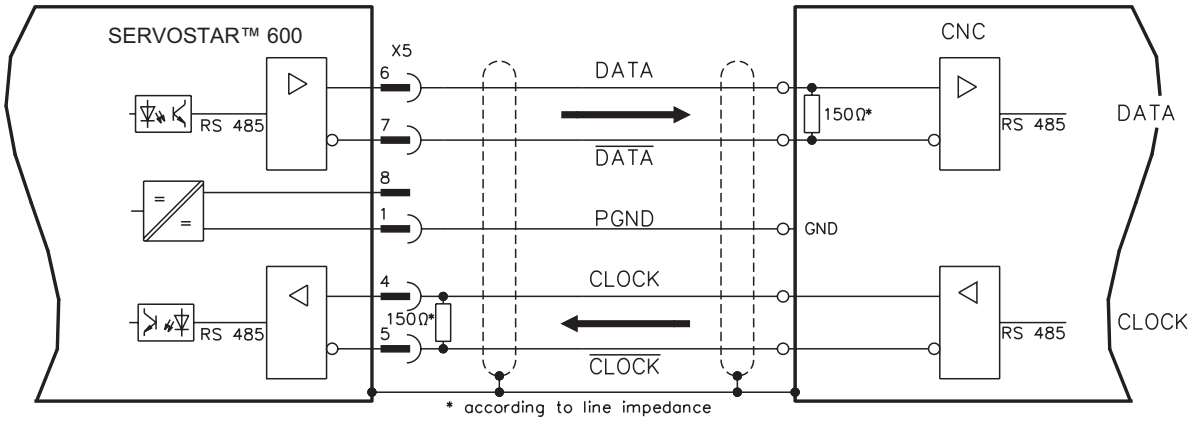
The interface must be read in as a multi-turn encoder, but delivers valid single-turn data. The signal sequence can be output in **Gray** code (standard) or in **binary** code (parameter SSI-CODE).

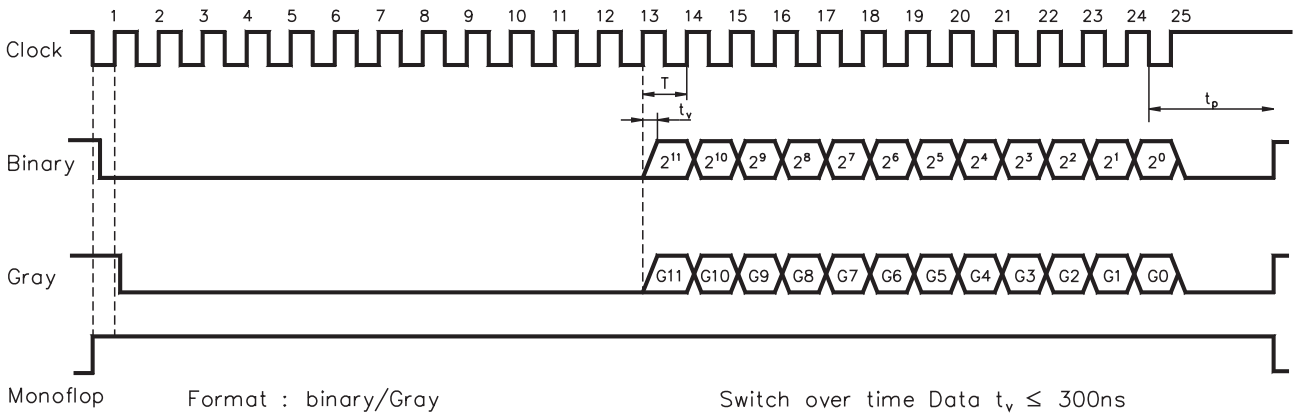
A serial signal is read out from the control, with a synchronous clock frequency of max. 1.5 MHz. The servo amplifier can be adjusted to the clock frequency of your SSI-evaluation with the SSI-TAKT parameter (200 kHz or 1.5MHz and inverted).

The drivers are supplied from an internal supply voltage.
PGND must always be connected to the controls.

Connection and signal description for SSI interface :

The count direction for the SSI interface is upwards when the motor shaft is rotating clockwise (looking at the shaft end).

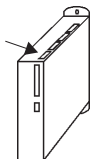




Format : binary/Gray
Transfer bit rate = 1,5 MBaud
Period T ≈ 600 ns

Switch over time Data $t_v \leq 300ns$
Monoflop stabilize time $t_p < 15\mu s$
$U_H \geq 2,0V/-20mA$ $U_L \leq 0,5V/+20mA$

III.7 RS232 interface, PC connection (X6)



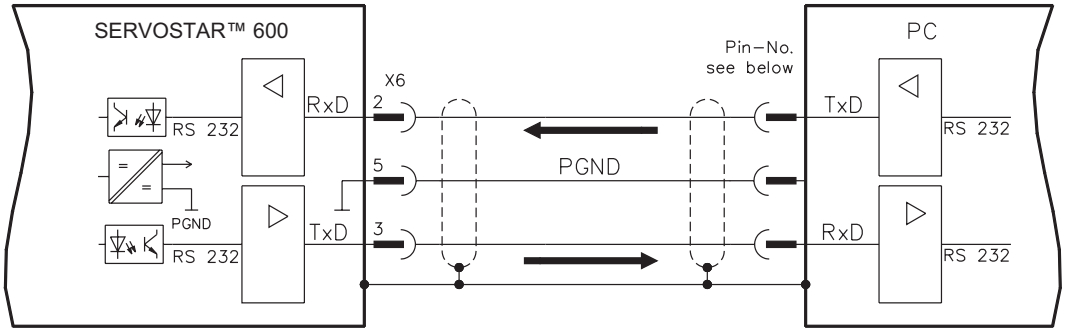
The setting of the operating, position control, and motion-block parameters can be carried out with an ordinary commercial PC.

Connect the PC interface (X6) of the servo amplifier **while the supply to the equipment is switched off** via a normal commercial 3-core null-modem cable to a serial interface on the PC.

Do not use a null-modem link cable!

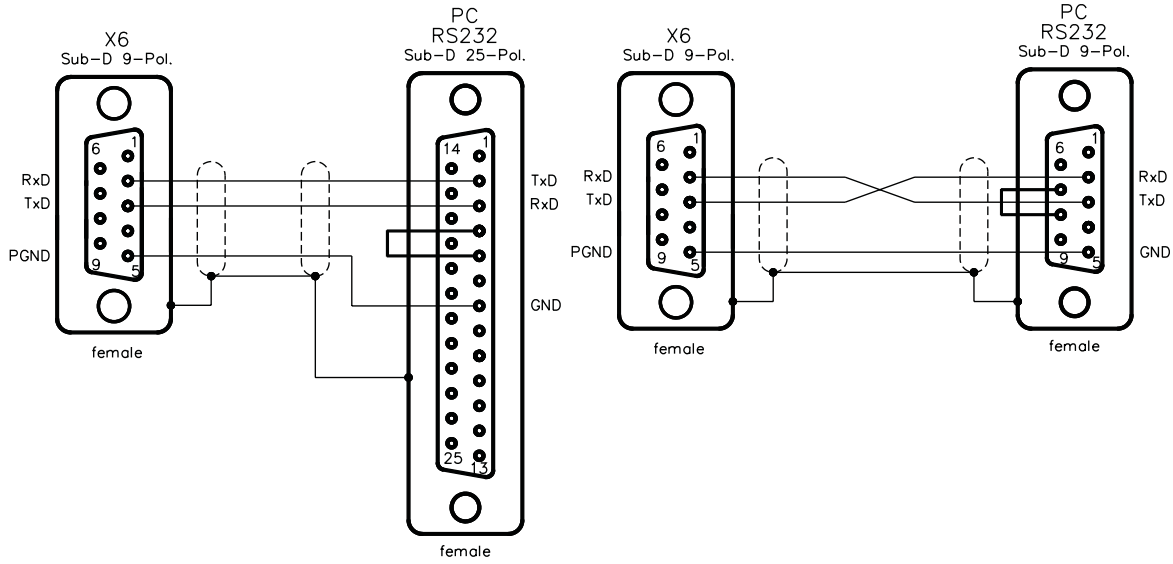
The interface is electrically isolated through an optocoupler, and is at the same potential as the CANopen interface.

The interface is selected and set up in the setup software.
Further notes can be found on page 31.

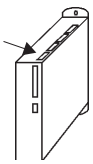


Interface cable between the PC and servo amplifiers of the SERVOSTAR™ 600 series:

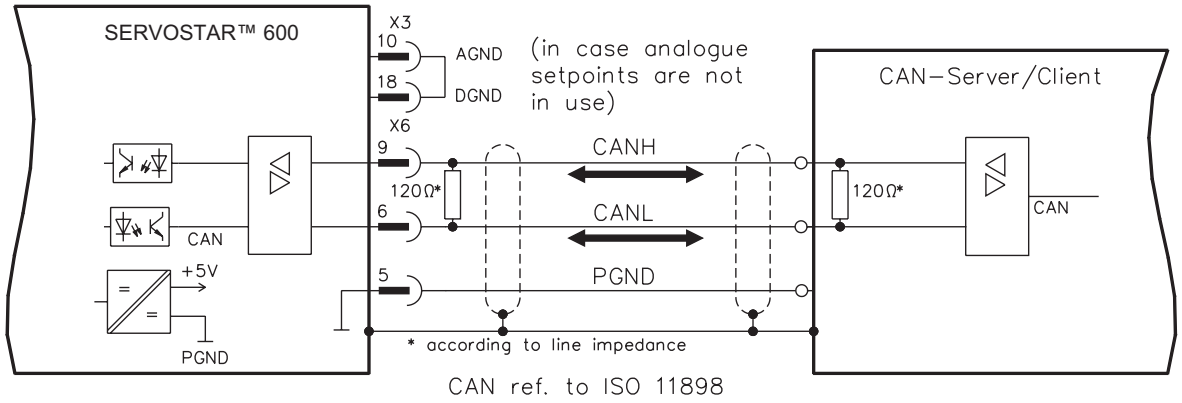
(View : looking at the face of the built-in SubD connectors, this corresponds to the solder side of the SubD sockets on the cable)



III.8 CANopen Interface (X6)



The interface for connection to the CAN bus (default 500 kBaud). The integrated profile is based on the communication profile CANopen DS301 and the drive profile DSP402. The following functions are available in connection with the integrated position controller:
Jogging with variable speed, reference traverse (zeroing), start motion task, start direct task, digital setpoint provision, data transmission functions and many others.
Detailed information can be found in the CANopen manual. The interface is electrically isolated by optocouplers, and is at the same potential as the RS232 interface. The analog setpoint inputs can still be used.
If the analog setpoint inputs are not used, then AGND and DGND (terminal X3) must be joined together !



CAN bus cable

To meet ISO 11898 you should use a bus cable with a characteristic impedance of 120 Ω. The maximum usable cable length for reliable communication decreases with increasing transmission speed. As a guide, you can use the following values which we have measured, but they are not to be taken as assured limits:

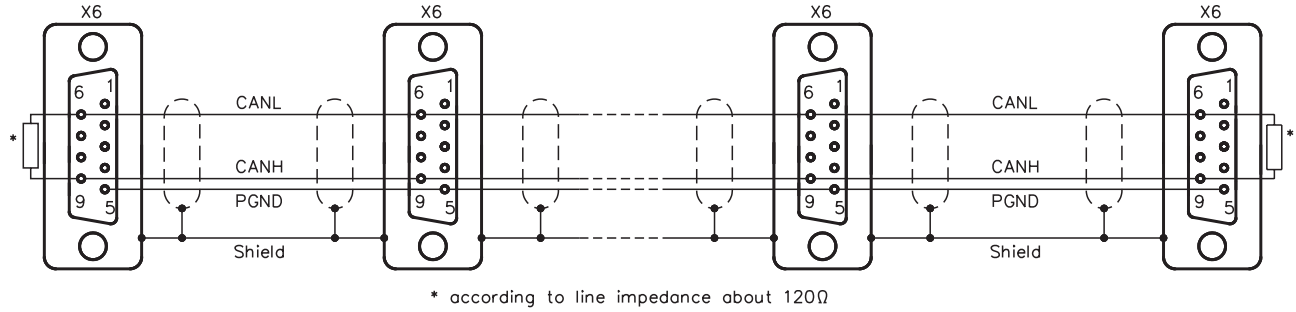
Cable data:	Characteristic impedance	100-120 Ω
	Cable capacitance	max. 60 nF/km
	Lead resistance (loop)	159.8 Ω/km

Cable length, depending on the transmission rate

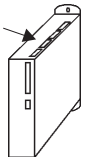
Transmission rate (kbaud)	max. cable length (m)
1000	20
500	70
250	115

Lower cable capacitance (max. 30 nF/km) and lower lead resistance
(loop, 115 Ω/km) make it possible to achieve greater distances.
(Characteristic impedance 150 ± 5Ω ⇒ terminating resistor 150 ± 5Ω).
For EMC reasons, the SubD connector housing must fulfill the following conditions:

- metal or metallized housing
- provision for cable shielding connection in housing, large-area connection

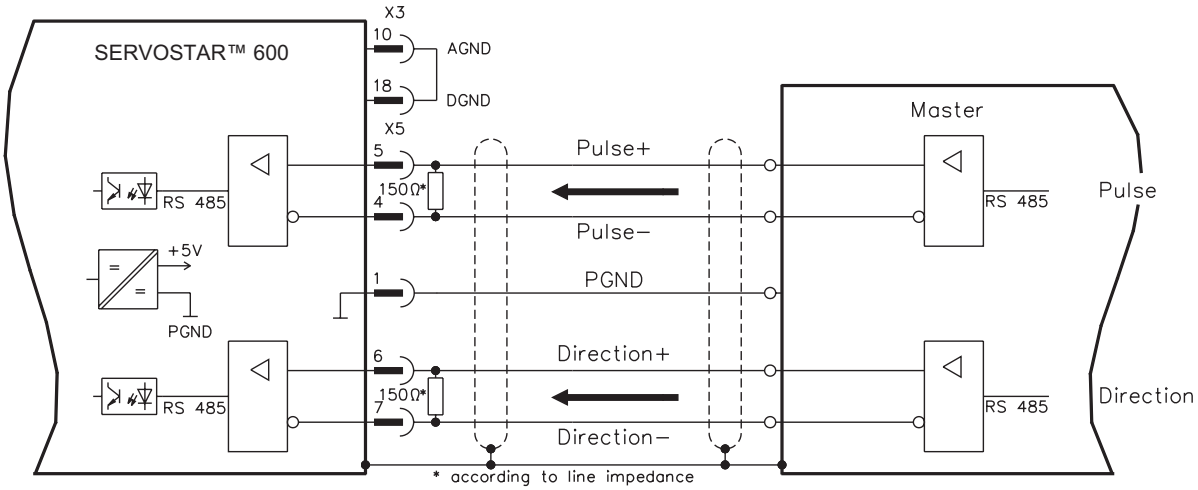


III.9 Interface for stepper-motor controls (X5)

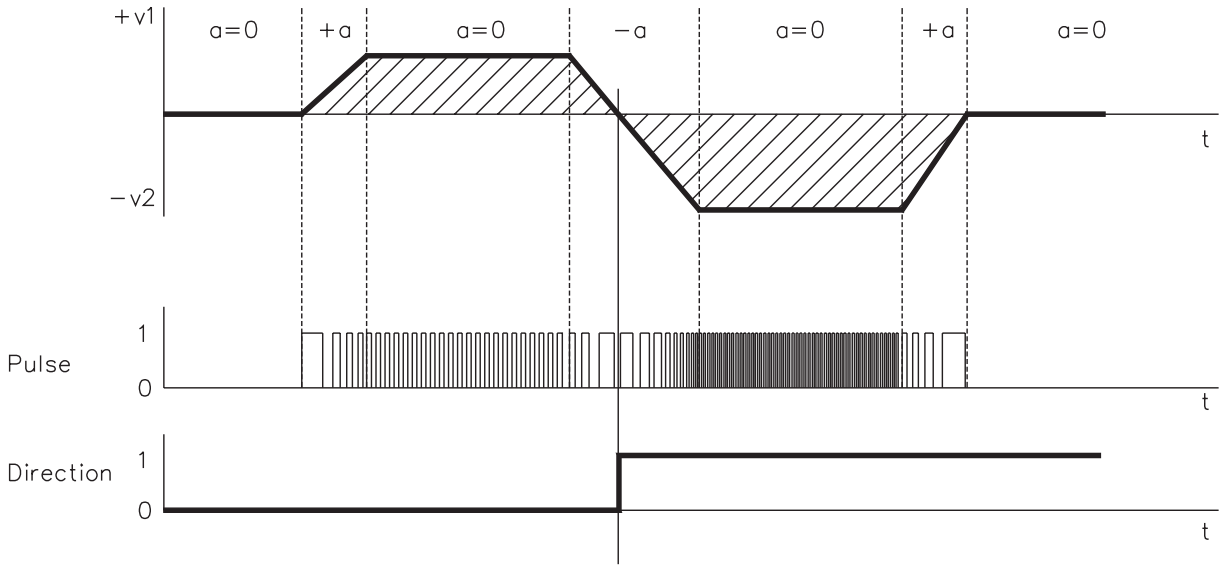


This interface can be used to connect the servo amplifier to a third-party stepper-motor controller. The parameters for the servo amplifier are set up with the aid of the setup software. The number of steps can be adjusted, so that the servo amplifier can be adjusted to the pulse-direction signals of any stepper-motor controller. Various monitoring signals can be output. The analog setpoint inputs are out of action.

AGND and DGND (terminal X3) must be joined together !



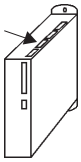
Speed profile and signal diagram



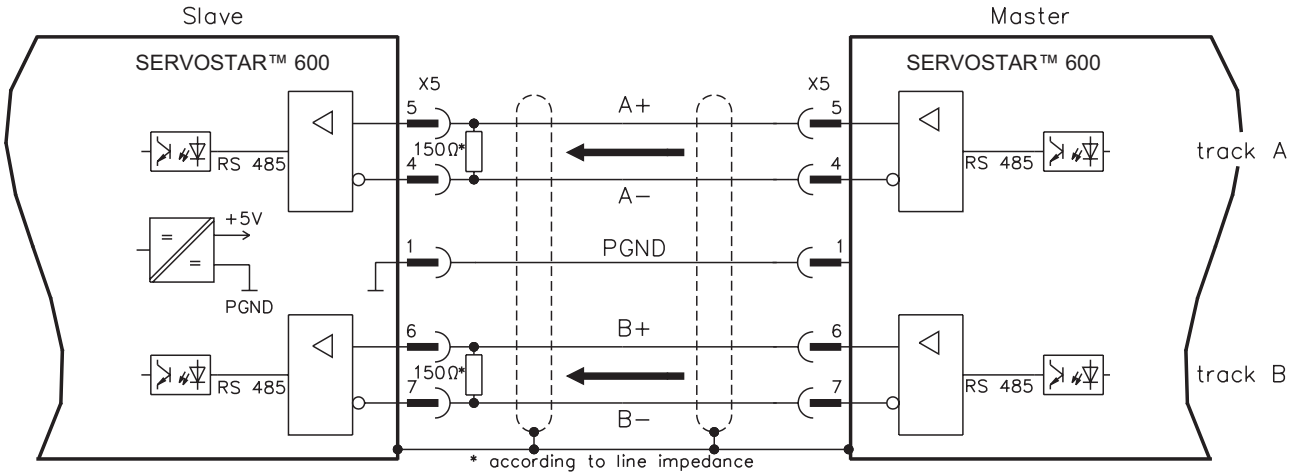
Derivatives:

Distance traversed s	——	no. of pulses
Velocity v	——	pulse frequency
Acceleration a	——	change of pulse frequency

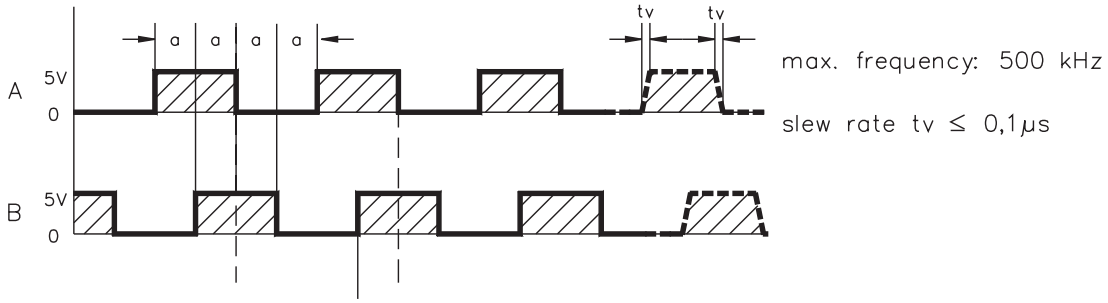
III.10 Interface for master-slave operation, encoder input (X5)



This interface can be used to link several SERVOSTAR™ 600 amplifiers together in master-slave operation.
Up to 16 slave amplifiers can be controlled by the master via the encoder output.
The parameters for the slave amplifiers are set up with the aid of the setup software.
The resolution (no. of pulses/turn) can be adjusted. The analog setpoint inputs are out of action.
AGND and DGND (terminal X3) must be joined together !



Signal diagram



IV Commissioning

IV.1 Important notes

Only professional personnel with extensive knowledge in the fields of electrical/ drive technology are allowed to commission the servo amplifier.

The procedure for commissioning is described as an example. Depending on the application, a different procedure may be sensible or necessary.

In multi-axis systems, commission each servo amplifier individually.

Caution !
Check that all live connecting elements are protected from accidental contact.
Deadly voltages can be present, up to 900V.
Never disconnect any of the electrical connections to the servo amplifier while it is live.
Capacitors can still have residual charges with dangerous levels up to 300 seconds after switching off the supply power.
Heat sinks and front panels of the amplifier can reach a temperature of up to 80°C in operation. Check (measure) the heat sink temperature. Wait until the heat sink has cooled down below 40°C before touching it.

Warning !
If the servo amplifier has been stored for longer than 1 year, then the DC-link capacitors will have to be re-formed.
To do this, disconnect all the electrical connections.
Supply the servo amplifier for about 30 min. from single-phase 230V AC to the terminals L1 / L2. This will re-form the capacitors.

Further information on commissioning :
The adaptation of parameters and the effects on the control loop behaviour are described in the manual for commissioning "QUICKSTART".
The commissioning of the expansion card (if present) is described in the corresponding manual on the CD-ROM.
We can provide further know-how through training courses (on request).

The following instructions should help you to carry out the commissioning in a sensible order, without any hazards to people or machinery.

Check installation

⇨ chapter II. **Disconnect the servo amplifier from the supply.**

Inhibit Enable signal

0V on terminal X3/15 (Enable)

Switch on 24V auxiliary voltage

24V DC on terminal X4/1, ground on terminal X4/3
After the initialisation procedure (about 0.5 sec.) the status is shown in the LED display (⇨ p.54)

Switch on PC, start setup software

Select the interface to which the servo amplifer is connected,
The parameters which are stored in the SRAM of the servo amplifer are transferred to the PC.

Check displayed parameters, and correct if necessary

Caution !
It is especially important to check the following parameters. If you do not set them properly, parts of the system can be damaged or destroyed.

Supply voltage	: set to the actual mains supply voltage
Rated motor voltage	: at least as high as the DC-link voltage of the amplifier
Motor pole-no.	: must match the motor (see motor manual)
Feedback	: must match the feedback unit in the motor
I_{RMS}	: maximum is the motor standstill curent I_0 (on nameplate)
I_{PEAK}	: maximum is 4 x motor standstill curent I_0
Limit speed	: maximum is the rated motor speed (on nameplate)
Regen power	: maximum is the permitted regen resistor dissipation
Station address	: unique address (see setup software manual)

Check safety devices

Caution !
Make sure that any unintended movement of the drive cannot cause danger to machinery or personnel.

Switch on supply power

through the ON/OFF button of the contactor control

Apply 0V setpoint

0V on terminals X3/4-5 or X3/6-7

Enable

(500 ms after switching on the supply power) 24V DC on terminal X3/15, motor stands with standstill torque M_0

Setpoint

apply a small analog setpoint, about 0.5V is recommended, to terminals X3/4-5 or X3/6-7
If the motor oscillates, the parameter Kp in the menu page "speed controller" must be reduced - the motor is endangered!

Optimization

Optimize speed, current and position controllers

Commissioning the expansion card

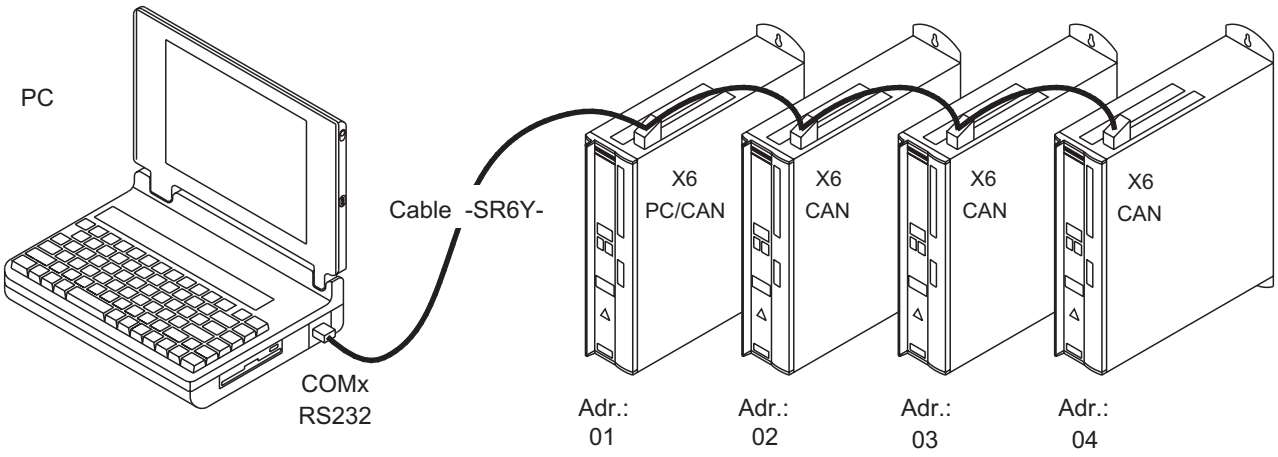
see commissioning instructions in the corresponding manual on the CD-ROM

IV.2 Parameter setting

A default parameter set is loaded into your servo amplifier by the manufacturer. This contains valid and safe parameters for the current and speed controllers.
A database for motor parameters is stored in the servo amplifier. During commissioning you must select the data set for the motor that is connected and store it in the servo amplifier. For most applications these settings will already provide good control loop characteristics.
An exact description of all parameters and the possibilities for optimizing the control loop characteristics can be found in the manual “Setup Software SR600.exe”.

IV.2.1 Multi-axis systems

Using a special cable, you can connect four servo amplifiers together and to your PC :
Cable type -SR6Y-, Mat. No. 90060, Drawing No. A.4.031.1/33



Baud rate identical for all amplifiers,
see table below

With the PC connected to just one servo amplifier you can now use the setup software to select all four amplifiers through the preset station addresses and set up the parameters.
During commissioning it makes sense to preset the station addresses for the individual amplifiers and the baud rate for communication by means of the keypad on the front panel (⇨ p.51). After changing the station adress and baud rate you must turn the 24V auxiliary supply of the servo amplifier off and on again.

Coding of the baud rate in the LED display :

Coding	Baud rate in kbit/s
0	10
1	20
2	50
3	100
4	125
5	250
6	333
7	500
8	666
9	800
10	1000

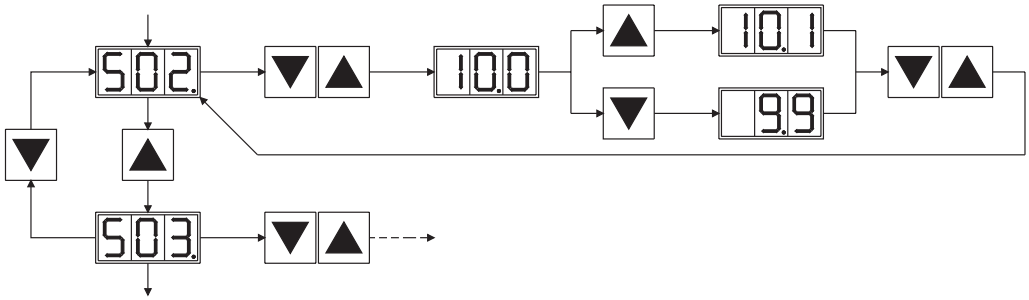
IV.2.2 Key operation / LED display

In this chapter the two possible operation menus and the use of the keys in the front panel are shown. Normally, the SERVOSTAR™ 600 only places the standard menu at your disposal. If you want to attend the amplifier via the detailed menu, you must keep the right key pressed while switching on the 24V-supply.

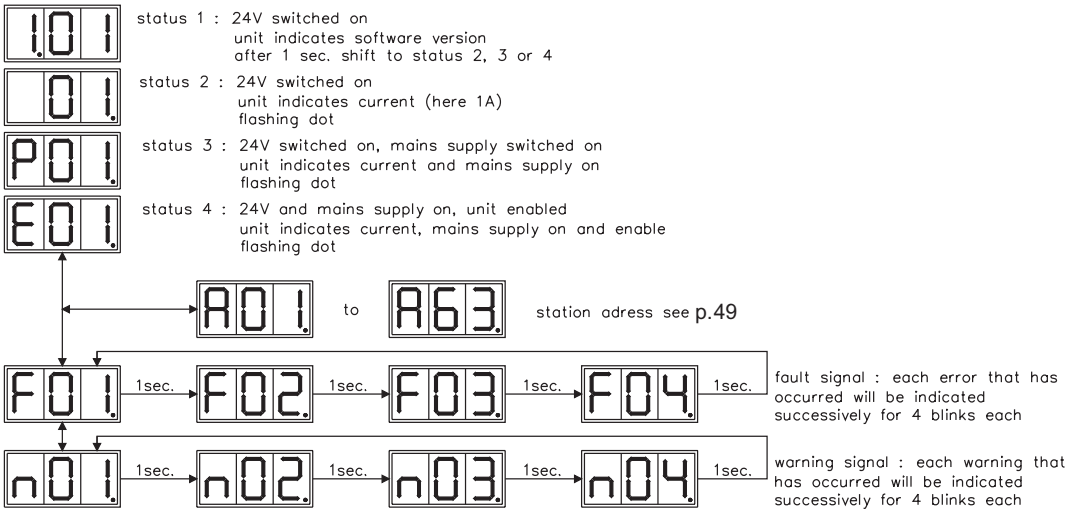
IV.2.2.1 Key operation

The two keys can be used to perform the following functions:

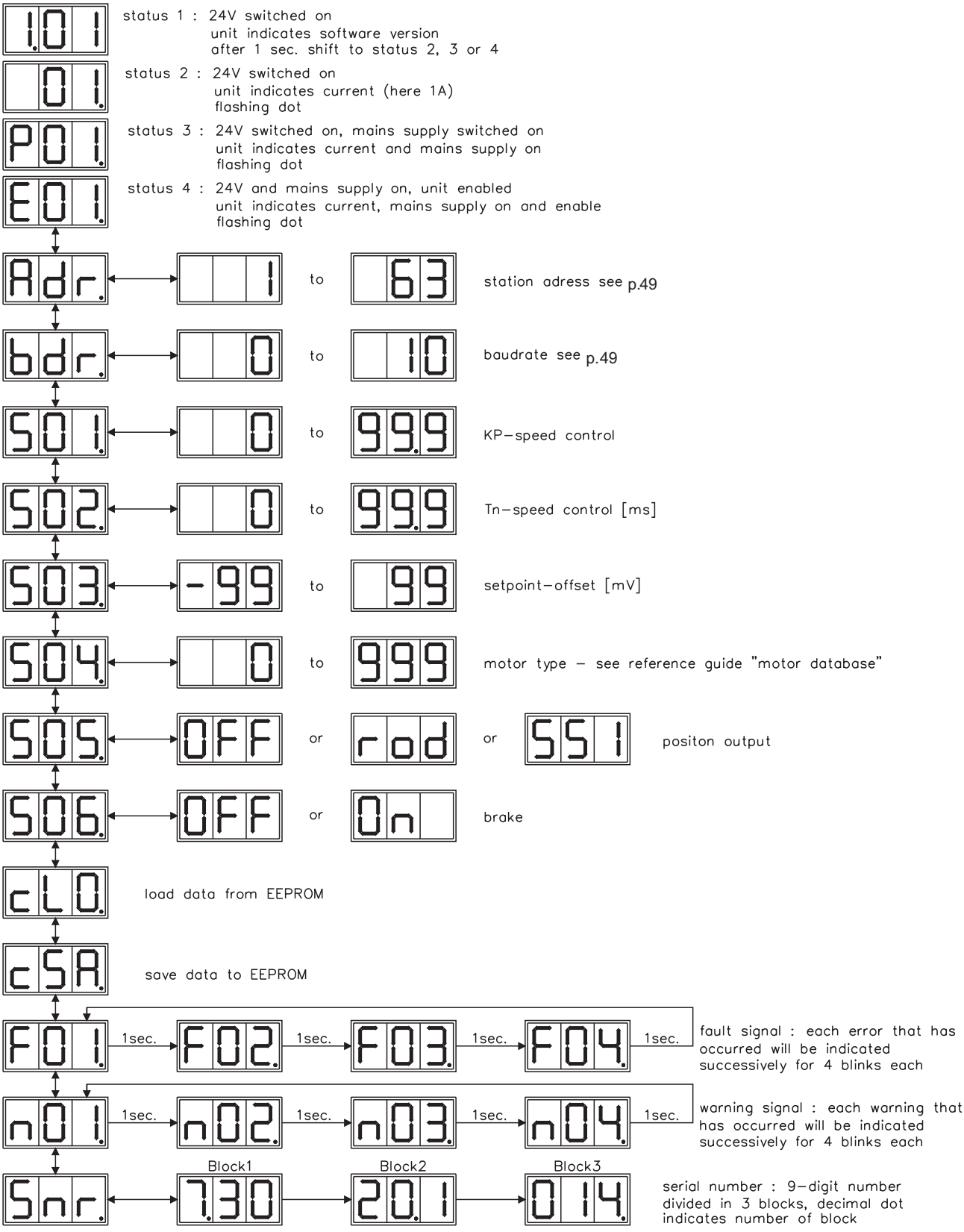
Key symbol	Functions
▲	**press once** : go up one menu item, increase number by one **press twice in rapid succession** : increase number by ten
▼	**press once** : go down one menu item, decrease number by one **press twice in rapid succession** : decrease number by ten
▲ ▼	**press and hold right key, then press left key as well :** enter a number, return function **name**



IV.2.2.2 Standard menu structure



IV.2.2.3 Extended menu structure



IV.3 Error messages

Errors which occur are shown in coded form by an error number in the LED display on the front panel. All error messages result in the BTB/RTO contact being opened, and the output stage of the amplifier being switched off (motor looses all torque). If a motor-holding brake is installed, it will be activated.

Number	Designation	Explanation
F01*	heat sink temperature	heat sink temperature too high limit is set by manufacturer to 80°C
F02*	overvoltage	overvoltage in DC-link limit depends on the mains supply voltage
F03*	following error	message from the position controller
F04	feedback	cable break, short circuit, short to ground
F05*	undervoltage	undervoltage in DC-link limit is set by manufacturer to 100V
F06	motor temperature	motor temperature too high limit is set by manufacturer to145°C
F07	aux. voltage	internal aux. voltage not OK
F08*	overspeed	motor running away, speed is too high
F09	EEPROM	checksum error
F10	Flash-EPROM	checksum error
F11	brake	cable break, short circuit, short to ground
F12	motor phase	motor phase missing (cable break or similar)
F13*	internal temperature	internal temperature too high
F14	output stage	fault in the output stage
F15	I^2t max	I^2t max. value exceeded
F16*	supply - BTB/RTO	2 or 3 phases missing in the supply feed
F17	A/D converter	error in the analog-digital conversion
F18	regen	regen circuit faulty or incorrect setting
F19	supply phase	a supply phase is missing (can be switched off for 2-phase operation)
F20	Slot fault	Hardware fault of the expansion card
F21	Handling fault	Software fault of the expansion card
F22-F31	reserved	reserved
F32	system error	system software not responding correctly

* = These error messages can be cancelled by the ASCII command CLRFAULT, without making a reset. If only these errors are present, and the RESET button or the I/O-function RESET is used, the CLRFAULT command is also all that is carried out.

IV.4 Warning messages

Faults which occur, but which do not cause a switch-off of the amplifier output stage (BTB/RTO contact remains closed) , are indicated in the LED display on the front panel by a coded warning number.

Number	Designation	Explanation
n01	I²t	I²t threshold exceeded
n02	regen power	preset regen power reached
n03*	S_fault	exceeded preset contouring error
n04*	response monitoring	response monitoring (fieldbus) is active
n05	supply phase	supply phase missing
n06*	Sw limit-switch 1	passed software limit-switch 1
n07*	Sw limit-switch 2	passed software limit-switch 2
n08	motion task error	a faulty motion task was started
n09	no reference point	no reference point set at start of motion task
n10*	PSTOP	PSTOP limit-switch activated
n11*	NSTOP	NSTOP limit-switch activated
n12	default values	only HIPERFACE® : motor default values were loaded
n13*	expansion card	expansion card not functioning correctly
n14	HIPERFACE®-reference mode	Attempt to reset while HIPERFACE®-reference mode was active
n14-n31	reserved	reserved
n32	Firmware beta version	The firmware is not a released beta version

* = These warning messages lead to a controlled shut-down of the drive (braking with the emergency ramp)

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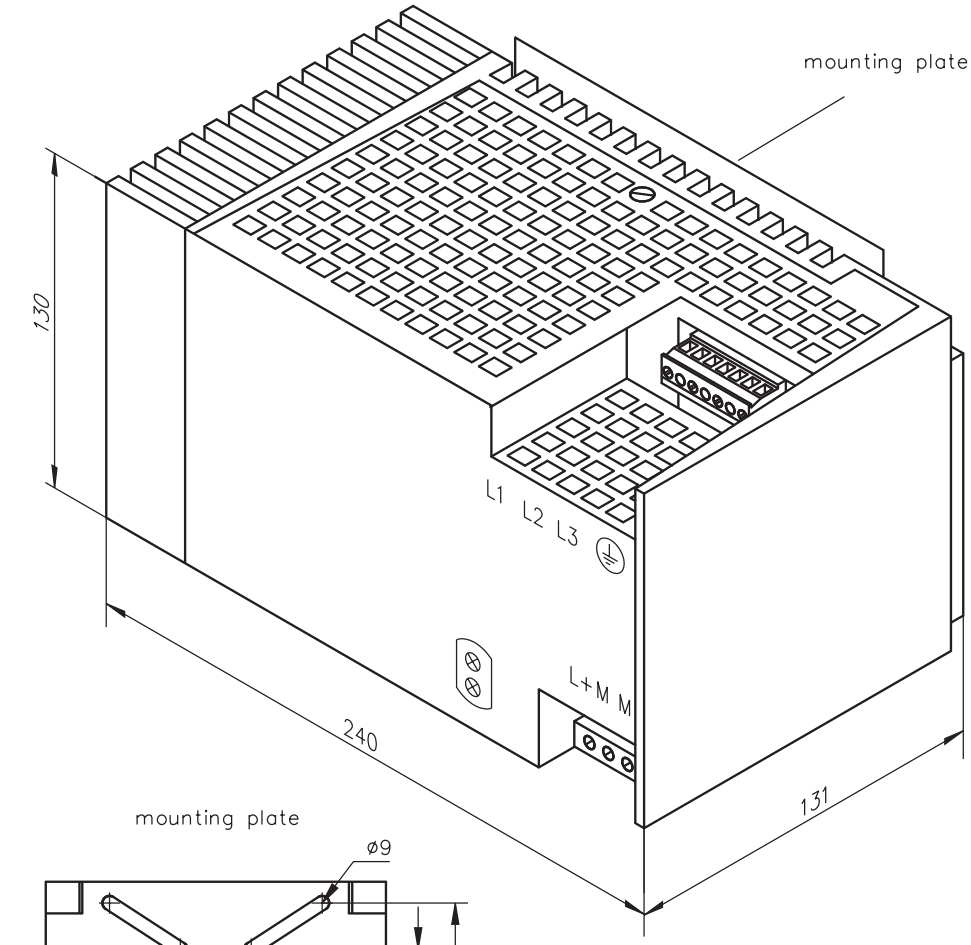
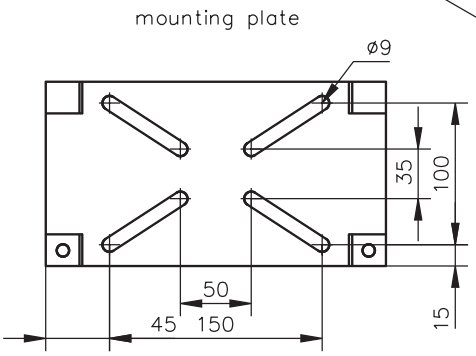
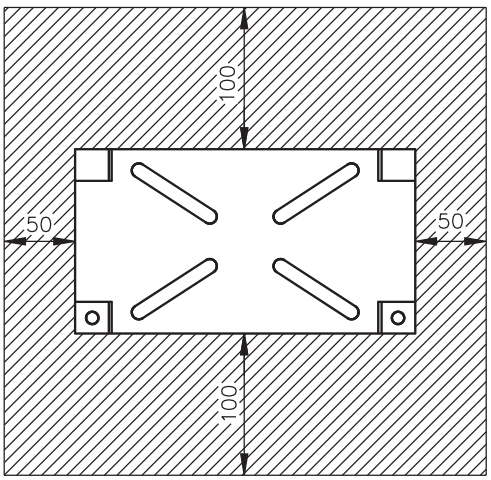
V Accessories

V.1 External 24V DC supply for up to 7 servo amplifiers

24V DC / 20A



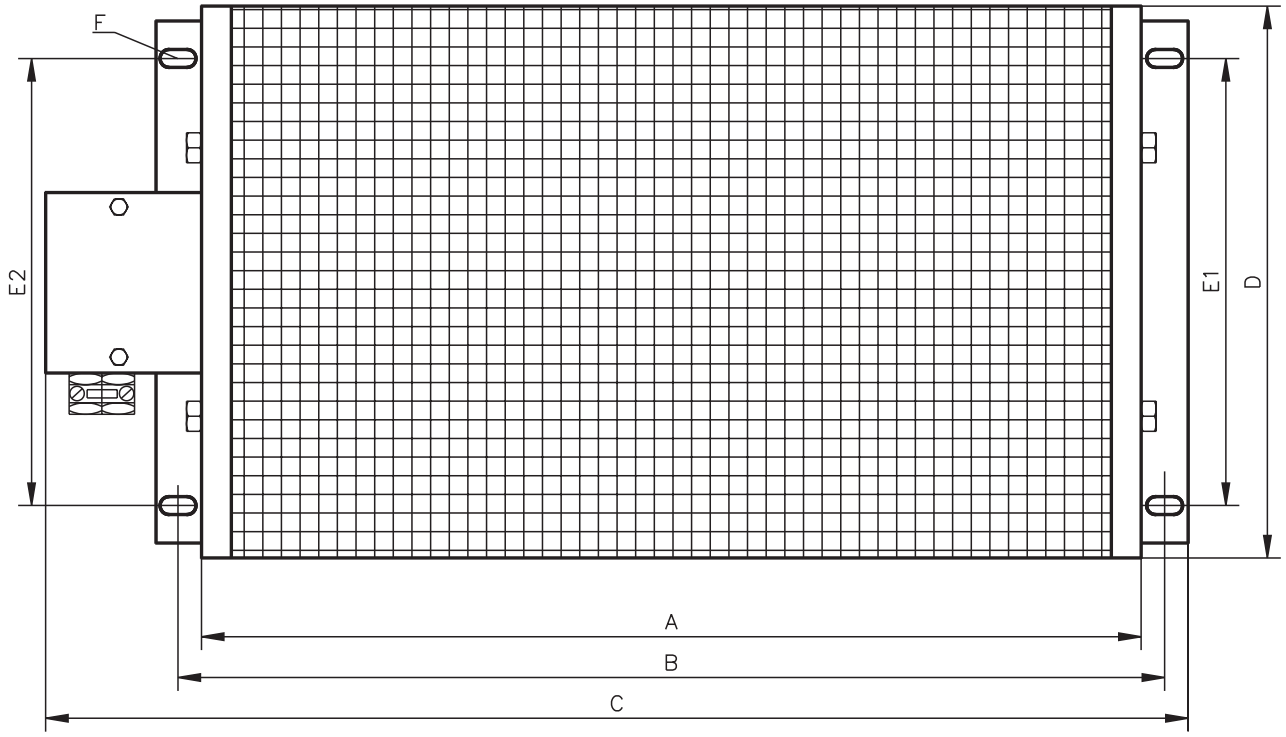


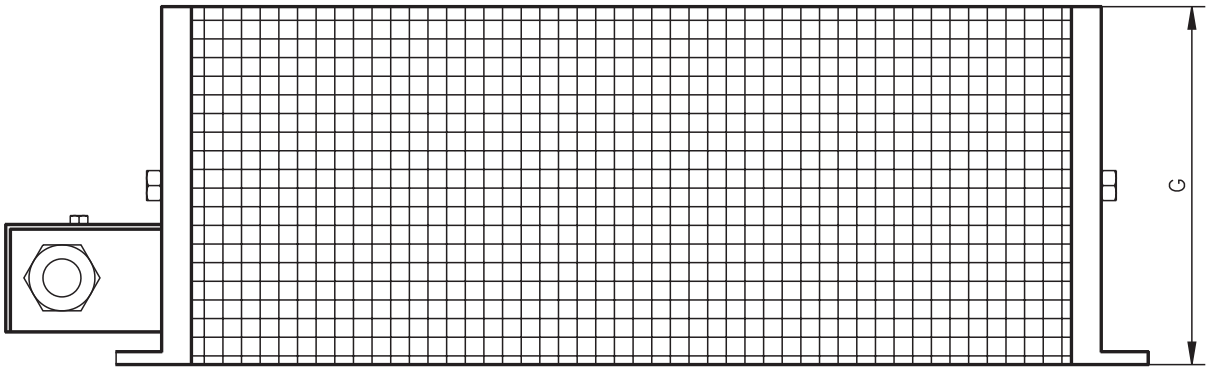


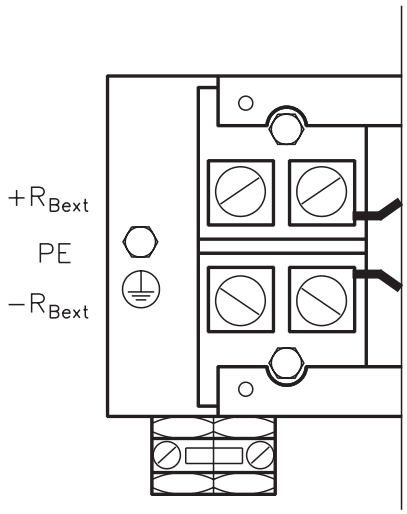
Specifications

Input voltage	3 x 400V AC ±10%
Input current	ca. 1,1A
Frequency	50/60 Hz
Primary fuse	none
Output voltage	24 V DC ±1%
Max. output current	20 A
Eff.residual ripple	< 0,1%
Output fuse	short circuit proof
Test voltage	acc. to VDE 0550
Temperature range	−20...+60°C
Type of mounting	mounting plate
Weight	3,5 kg
Order no.	81279

V.2 External regen resistor BARxxx

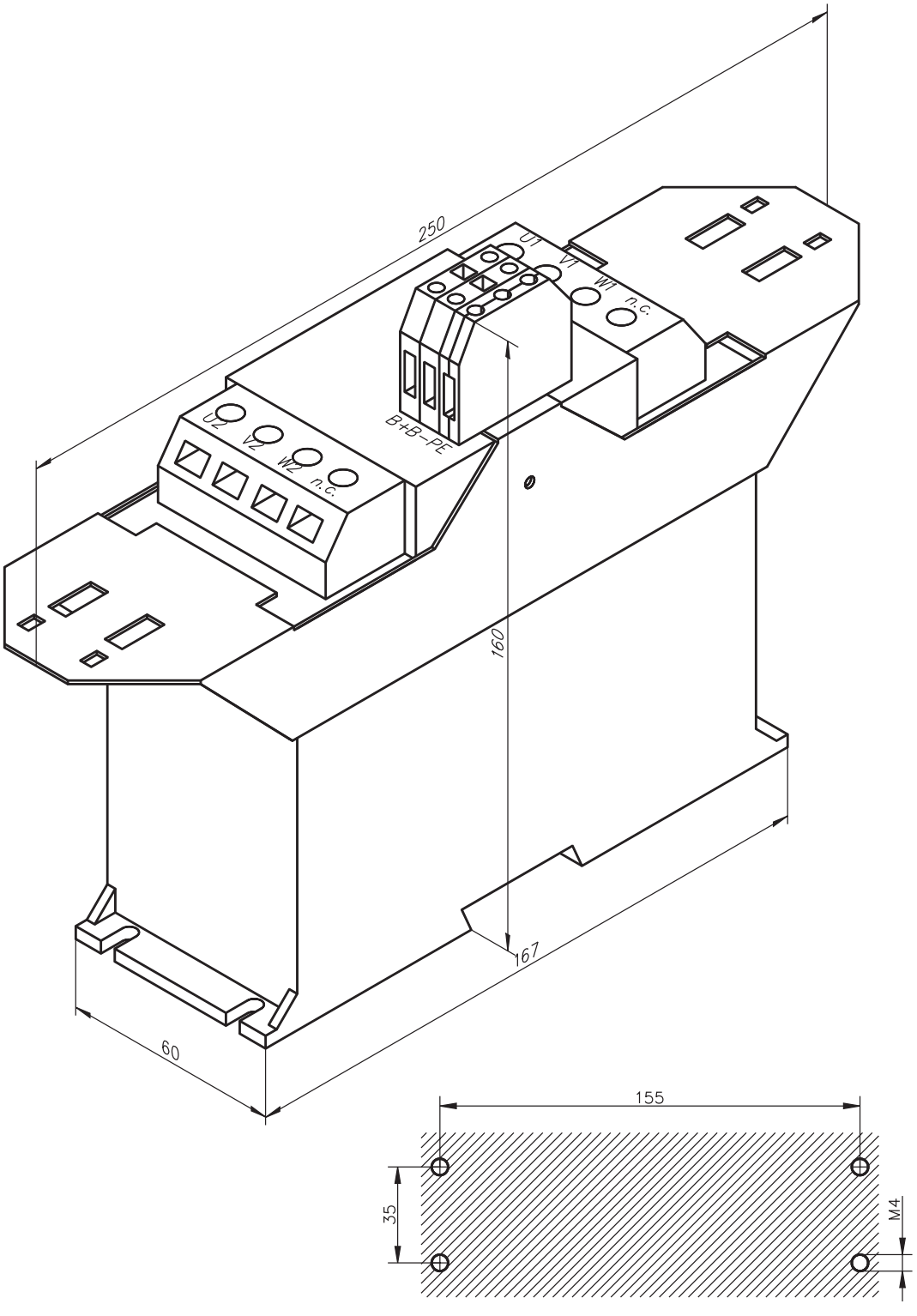






	R	A	B	C	D	E1	E2	F	G	weight	valid for
	Ω	mm	mm	mm	mm	mm	mm	mm	mm	Kg	
BAR 250	33	330	390	412	66	44	35	4,5x9	77	1,2	
BAR 500	33	400	426	486	92	64	64	6,5x12	120	2,3	
BAR 1500	33	500	526	586	185	150	150	6,5x12	120	5,2	
BAR 860	15	300	326	386	92	64	64	6,5x12	120	3,5	
BAR 1600	10	500	526	586	185	150	150	6,5x12	120	5,2	

V.3 Motor choke box 3YL-20



Technical data:

Nom. data	Sym	DIM	3 YL-20
Rated corrent	I_{0rms}	A	Max. 3 x 20
Frequency	f_{max}	kHz	8.3
Inductance	L	mH	1.2

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VI Appendix

VI.1 Transport, storage, maintenance, disposal

Transport :
— only by qualified personnel
— only in the manufacturer's original recyclable packaging
— avoid shocks
— temperature –25 to +70°C, max. 20°C / hour rate of change
— humidity max. 95% relative humidity, no condensation
— the servo amplifiers contain electrostatically sensitive components which can be damaged by incorrect handling
Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.).
Place the servo amplifier on a conductive surface.
— if the packaging is damaged, check the unit for visible damage.
In this case, inform the shipper and the manufacturer.

Storage :
— only in the manufacturer's original recyclable packaging
— the servo amplifiers contain electrostatically sensitive components which can be damaged by incorrect handling
Discharge yourself before touching the servo amplifier. Avoid contact with highly insulating materials (artificial fabrics, plastic films etc.),
Place the servo amplifier on a conductive surface.
— max. stacking height 10 cartons
— storage temperature –25 to +55°C, max. 20°C/hr. rate of change
— humidity relative humidity max. 95%, no condensation
— storage duration < 1 year without restriction
> 1 year : capacitors must be **re-formed** before the servo amplifier is commissioned.
To re-form, remove all electrical connections, and supply the servo amplifier for about 30 min. from 230V AC, single-phase, on terminals L1 / L2.

Maintenance :
— the instruments do not require any maintenance
— opening the enclosure invalidates the warranty

Cleaning :
— if the casing is dirty, clean with Isopropanol or similar cleaning agent
Do not immerse or spray.
— dirt inside the unit must be cleaned by the manufacturer
— dirty protective grill (fan) may be cleaned with a dry brush

Disposal :
— the servo amplifier can be reduced to its principal components by removing the screws (aluminium heat sink and front panel steel housing sections, electronics boards)
— disposal should be carried out by a certified disposal company.
We can give you suitable addresses.

VI.2 Removing faults

The table below should be regarded as a “First-aid” box. Depending on the conditions in your installation, there may be a wide variety of reasons for the fault.
In multi-axis systems there may be further hidden causes of a fault.
Our applications department can give you further assistance with problems.

Fault	possible causes	Measures to remove the cause of the fault
message: communication fault	— wrong cable used — cable plugged into wrong position in servo amplifier or PC — wrong PC interface selected	— use null-modem cable — plug cable into the correct sockets on the servo amplifier and PC — select correct interface
message: undervoltage	— supply voltage not present or too low when servo amplifier is enabled	— only enable the servo amplifier when the mains supply voltage has been switched on delay > 500 ms
message: overvoltage	— regen power is insufficient. regen power limit was reached and the regen resistor was switched off. This causes excessive voltage in the DC-link circuit. — supply voltage too high	— shorten the braking time RAMP or use an external regen resistor with a higher power rating and adjust the regen power parameter — use mains transformer
message: mains BTB/RTO	— enable was applied, although the supply voltage was not present. — at least 2 supply phases are missing	— only enable the servo amplifier when the mains supply voltage has been switched on — check electrical supply
message: brake	— short-circuit in the supply cable for the motor-holding brake — motor-holding brake is faulty — fault in brake cable — no brake connected, although the brake parameter is set to "WITH"	— remove short-circuit — replace motor — check shielding of brake cable — brake parameter set to "WITHOUT"
message: output stage fault	— motor cable has short-circuit/ground short — motor has short-circuit / ground short — output module is overheated — output stage is faulty — short-circuit / short to ground in the external regen resistor	— replace cable — replace motor — improve ventilation — return the servo amplifier to the manufacturer for repair — remove short-circuit / ground short
message: heat sink temperature	— permissible heat sink temperature exceeded	— improve ventilation
message: aux. voltage	— the aux. voltage produced by the servo amplifier is incorrect	— return the servo amplifier to the manufacturer for repair

Fault	possible causes	measures to remove the cause of the fault
message: feedback unit	— feedback connector not properly inserted — feedback cable is broken, crushed or otherwise damaged	— check connector — check cable
message: internal temperature	— permissible internal temperature exceeded	— improve ventilation
Message: motor temperature	— motor thermostat has been activated — feedback connector is loose or break in feedback cable	— wait until motor has cooled down, then check why it became so hot — tighten connector or use new feedback cable
motor does not rotate	— servo amplifier not enabled — break in setpoint cable — motor phases swapped — brake not released — drive is mechanically blocked — no. of motor poles set incorrectly — feedback set up incorrectly	— apply enable signal — check setpoint cable — correct motor phase sequence — check brake control — check mechanism — set no. of motor poles — set up feedback correctly
motor runs away (overspeed)	— motor phases swapped — feedback set up incorrectly	— correct motor phase sequence — set up correct offset angle
motor oscillates	— gain too high (speed controller) — shielding in feedback cable has a break — AGND not wired up	— reduce Kp (speed controller) — replace feedback cable — join AGND to CNC-GND
drive reports following error	— I_{rms} or I_{peak} is set to low — setpoint ramp is too long	— increase I_{rms} or I_{peak} (keep within motor data !) — shorten setpoint ramp +/-
motor overheating	— I_{rms}/I_{peak} set too high	— reduce I_{rms}/I_{peak}
drive too soft	— Kp (speed controller) too low — Tn (speed controller) too high — PID-T2 too high — T-Tacho too high	— increase Kp (speed controller) — use motor default value for Tn (speed controller) — reduce PID-T2 — reduce T-Tacho
drive runs roughly	— Kp (speed controller) too high — Tn (speed controller) too low — PID-T2 too low — T-Tacho too low	— reduce Kp (speed controller) — use motor default value for Tn (speed controller) — increase PID-T2 — increase T-Tacho
axis drifts at setpoint = 0V	— offset not correctly adjusted for analog setpoint provision — AGND not joined to the CNC-GND of the controls	— adjust setpoint-offset (analog I/O) — join AGND and CNC-GND

VI.3 Glossary

C	Clock	Clock signal
	Common-mode voltage	The maximum amplitude of a disturbance (on both inputs) which a differential input can eliminate
	CONNECT- modules	Modules built into the servo amplifier, with integrated position control, which provide special versions of the interface for the connection to the higher-level control
	Continuous power of regen circuit	Mean power which can be dissipated in the regen circuit
	Counts	Internal count pulses, 1 pulse = $1/2^{20}$ $turn^{-1}$
	Current controller	Regulates the difference between the current setpoint and the actual value to 0 Output : power output voltage
D	DC-link	Rectified and smoothed power voltage
	Disable	Removal of the enable signal (0V or open)
E	Enable	Enable signal for the servo amplifier (+24V)
F	Final speed	Maximum value for speed normalization at ±10V
	Fieldbus interface	here: CONNECT modules: CAN-CONNECT and PROFIBUS-CONNECT
G	GRAY-code	Special method of representing binary numbers
H	Holding brake	Brake in the motor, which can only be used when the motor is at a standstill
I	I²t threshold	Monitoring of the actually required r.m.s. current
	Input drift	Temperature and age-dependent alteration of an analog input
	Incremental encoder interface	Position signalling by 2 signals with 90° phase difference, not an absolute position output
	Ipeak, peak current	The effective value of the peak current
	Irms, effective current	The r.m.s. value of the continuous current
K	Kp, P-gain	Proportional gain of a control loop
L	Limit-switch	Switch limiting the traverse path of the machine; implemented as n.c. (break) contact
M	Machine	The complete assembly of all connected parts or devices, of which at least one is movable
	Monitor output	Output of an analog measurement
	Motion-block	Data packet with all the position control parameters which are required for a motion task, only when a CONNECT- module is present
	Multi-axis system	Machine with several independently driven axes
N	Natural convection	Free movement of air for cooling
O	Optocoupler	Optical connection between two electrically independent systems

P	P-controller	Control loop with purely proportional behaviour
	Phase shift	Compensation for the lag between the electromagnetic and magnetic fields in the motor
	PID-controller	Control loop with proportional, integral and differential behaviour
	PID-T2	Filter time constant for the speed controller output
	Position controller	Regulates the difference between the position setpoint and the actual position to 0 Output : speed setpoint
	Potential isolation	Electrically decoupled
	Power contactor	System protection device with phase monitoring
	Pulse power of the regen circuit	Maximum power which can be dissipated in the regen circuit
R	Regen circuit	Converts superfluous energy, which is fed back during braking, into heat in the regen resistor
	Reset	New start of the microprocessor
	Resolver-digital converter	Conversion of the analog resolver signals into digital information
	Reversing mode	Operation with a periodic change of direction
	Ring core	Ferrite rings for interference suppression
	ROD-Interface	Incremental position output
S	Servo amplifier	Control device for regulating the position of a servomotor
	Setpoint ramps	Limits for the rate of change of the speed setpoint
	Short to ground	Electrically conductive connection between a phase and PE (protective earth)
	Short-circuit	here: electrically conductive connection between two phases
	Speed controller	Regulates the difference between the speed setpoint and the actual value to 0 Output : current setpoint
	SSI-interface	Cyclic-absolute, serial position output
	Supply filter	Device to divert interference on the power supply cables to PE
T	T-tacho, tachometer time constant	Filter time constant in the speed feedback of the control loop
	Tachometer voltage	Voltage proportional to the actual speed
	Thermostat	Temperature-sensitive switch built into the motor winding
	Tn, I-integration time	Integral section of a control loop
Z	Zero pulse	Output once per turn from incremental encoders, used to zero the machine

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